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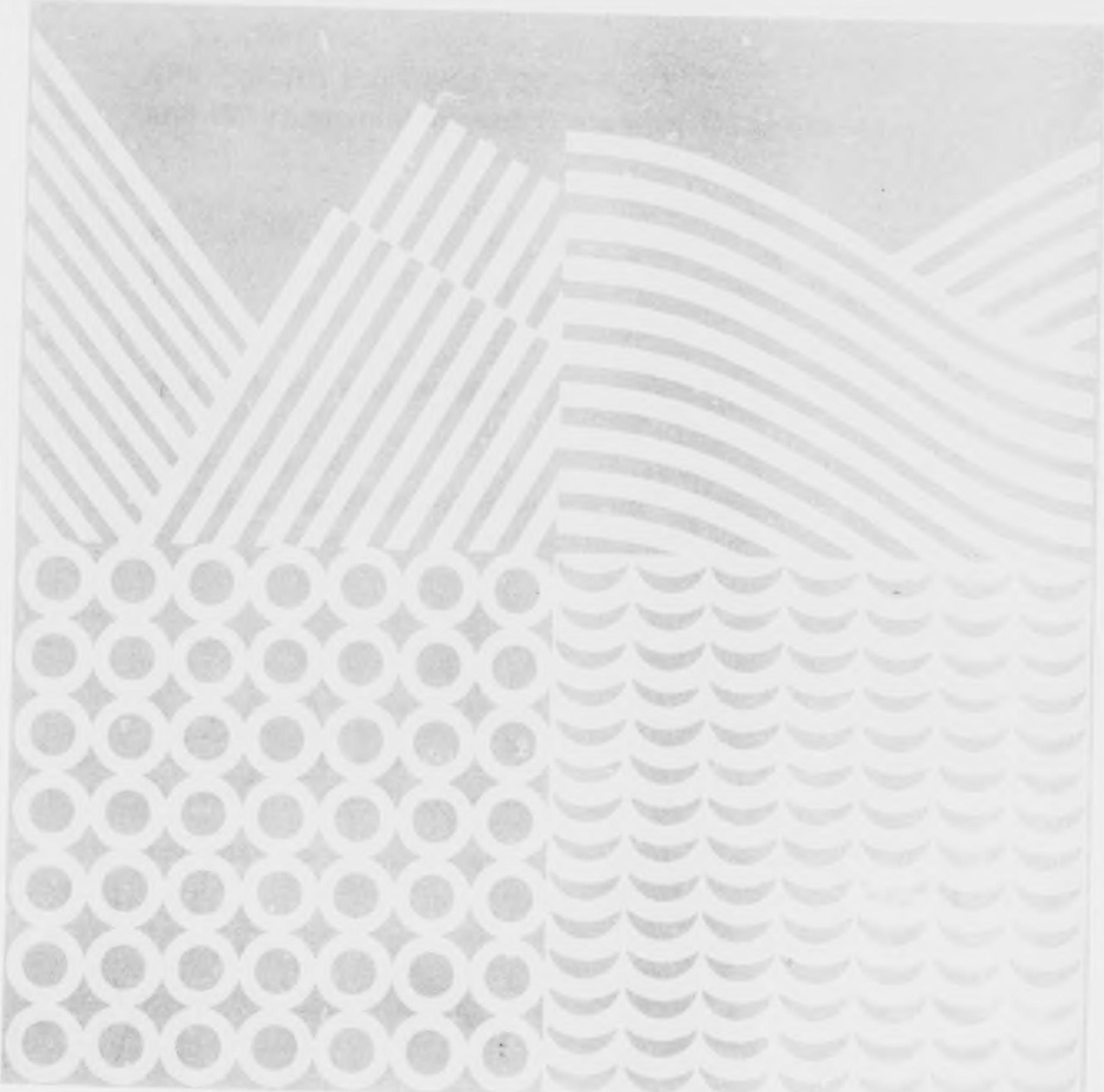
Red Rim, Wyoming Petition Evaluation Document/ Environmental Impact Statement

Final

522 SMCRA Evaluation
OSM-PE-5
and Environmental Impact
Statement OSM-EIS-13

U.S. Department of the Interior
Office of Surface Mining



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Red Rim, Wyoming Petition Evaluation Document/ Environmental Impact Statement

522 SMCRA Evaluation OSM-PE-5
and Environmental Impact Statement OSM-EIS-12

October 1985

Type of Action: Administrative

Prepared by the
U.S. Office of Surface Mining Reclamation and Enforcement

Jed D. Christensen
Acting Director

COVER SHEET

A. TITLE OF DOCUMENT

Red Rim, Wyoming, Final Petition Evaluation Document/Environmental Impact Statement (PED/EIS)

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C. ABSTRACT

On May 10, 1982, the National Wildlife Federation and the Wyoming Wildlife Federation filed with the Wyoming Department of Environmental Quality (DEQ) a petition to have certain privately owned lands in the Red Rim area, near Rawlins, Wyoming, designated as unsuitable for surface coal mining operations. The two federations later filed a supplement to this petition with Wyoming DEQ to include Federal lands interspersed among these privately owned lands as part of their petition area. OSM received copies of this supplement and of the original petition on September 27, 1982. The major allegations of the petition area that (1) surface coal mining operations in the Red Rim petition area would adversely affect fragile land that is valuable habitat for pronghorn and (2) reclamation of this land in accordance with the Surface Mining Control and Reclamation Act of 1977 is not technologically and economically feasible. This PED/EIS analyzes these allegations.

The analyses in this PED/EIS support the conclusion that, should the petition area be mined, reclaiming it using standard reclamation practices (those reclamation techniques that both minimally comply with the requirements of the Wyoming State program and are currently being used in the State to reclaim areas disturbed by surface coal mining operations) would cause significant adverse impacts to pronghorn within the Baggs Herd. The alteration of the topography and vegetation patterns of the petition area, the reduction of vegetation densities and diversity within the area, and the reduction of forage for pronghorn within the area would reduce the carrying capacity of mined portions of the Red Rim pronghorn critical winter range over the long term, possibly for a very long period following mining and reclamation. The cumulative long-term loss of pronghorn resulting

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from this long-term reduction of carrying capacity could therefore be large; adverse impacts to the herd from the reduction could be significant. In addition to these long-term impacts, mining and reclamation would result in significant, short-term adverse impacts to the Baggs Herd. OSM estimates that, during a severe winter, pronghorn mortality owing directly to habitat loss due to mining could range from 53 to 1,205 (0.7 to 17 percent of the herd), depending upon the extent of unreclaimed mining disturbance at the time the severe winter occurred. Assuming that a severe winter occurred once every 5 years, approximately 6,800 pronghorn could die over the life of the mine as the direct result of habitat loss.

Several other factors could account for considerable additional pronghorn losses over the short term. Among these are that (1) fences, spoil piles, pits, and other mining-related disturbances and facilities would exclude pronghorn from portions of the critical winter range, exposing them to the elements during severe snowstorms and causing them to overexert themselves to move around barriers and to locate shelter and accessible forage elsewhere; exposure and overexertion would, in turn, lead to increased mortality and decreased reproductive capability; (2) fences could entangle pronghorn trying to cross them or otherwise entrap pronghorn during severe snowstorms; and (3) poaching, road kills, and harassment would increase owing to the influx and increased activity of people in the Red Rim area.

The PED/EIS also finds that reclamation using standard reclamation practices is technologically and economically feasible. In addition, reclaiming the topography and vegetation of the petition area to closely approach their premining conditions, as the petitioners allege must be done, would be be possible; however, this type of reclamation would cost more than would reclamation using standard reclamation practices and the certainty of its success would be less. The PED/EIS does not conclusively show that reclaiming the petition area to closely approach its premining condition would be technologically and economically infeasible.

The Secretary of the Interior is required to make a decision to grant or deny the petition as it pertains to Federal lands. The alternative decisions available to him are (1) to designate the entire petition area as unsuitable for all surface coal mining operations (alternative A); (2) to not designate any of the petition area as unsuitable for surface coal mining operations (alternative B); (3) to designate parts of the petition area as unsuitable for surface coal mining operations (alternative C); and (4) to designate the entire petition area as unsuitable for surface coal mining, but to allow underground mining (alternative D). The Secretary's decision will not apply to the petition as it relates to private lands. On May 22, 1985, the Wyoming Environmental Quality Council decided by a vote of four to three not to designate any of the private lands within the petition area as unsuitable for surface coal mining operations.

SUMMARY

A. BRIEF EXPLANATION OF THE PETITION PROCESS

The criteria for assessing the unsuitability of an area for surface coal mining operations are provided by the Surface Mining Control and Reclamation Act of 1977 (SMCRA), Sections 522(a)(3)(B) and 522(c). In accordance with these criteria, the regulatory authority responsible for administering surface coal mining operations in the area to which the petition pertains shall designate that area as unsuitable if it determines that reclamation of the area, pursuant to the requirements of SMCRA, is not technologically and economically feasible (Section 522(a)(2) of SMCRA). The regulatory authority may designate the area as unsuitable if surface coal mining operations would (1) be incompatible with existing State or local land-use plans or programs (Section 522(a)(3)(A) of SMCRA); or (2) affect fragile or historic lands, in which such operations could result in significant damage to important historic, cultural, scientific, and esthetic values and natural systems (Section 522(a)(3)(B) of SMCRA); or (3) affect renewable-resource lands, in which such operations could result in a substantial loss or reduction of long-range productivity of water supply or of food or fiber products, and such lands to include aquifers and aquifer recharge areas (Section 522(a)(3)(C) of SMCRA); or (4) affect natural-hazard lands, in which such operations could substantially endanger life or property, such lands to include areas subject to flooding and areas of unstable geology (Section 522(a)(3)(D) of SMCRA).

B. DESCRIPTION OF THE RED RIM PETITION

Issues.--The major allegations of the Red Rim unsuitability petition (appendix A) are that (1) surface coal mining operations in the Red Rim petition area would adversely affect fragile land that is valuable habitat for pronghorn and (2) reclamation of this land in accordance with SMCRA would not be technologically and economically feasible.

Events.--On May 10, 1982, the National Wildlife Federation and the Wyoming Wildlife Federation submitted to the Wyoming Department of Environmental Quality (DEQ) a petition to have certain lands in the Red Rim area, near Rawlins, Wyoming, designated as unsuitable for surface coal mining operations. On June 2, 1982, Wyoming DEQ rejected allegation 2 of this petition (alleging that reclamation of the petition area to wildlife habitat, as mandated by SMCRA and the Wyoming Environmental Quality Act (WEQA), is not feasible) as frivolous. At the same time, Wyoming DEQ informed the petitioners that any petition whose allegations rely on the definition of "fragile lands" cannot be considered complete until the petitioners first identify a geographic area containing the fragile lands that could be damaged by surface coal mining operations. Wyoming DEQ considered that the petitioners did not specifically define such a geographic area. Rather, the petitioners identified certain parcels of land and failed to identify certain other (Federal) parcels interspersed among them.

On October 12, 1982, the petitioners filed an appeal with the Wyoming Environmental Quality Council (EQC) to reverse Wyoming DEQ's decision to reject allegation 2. On January 24, 1985, at a hearing held by the Office of Surface Mining Reclamation and Enforcement (OSM) and Wyoming EQC to receive comments from the public on the petition and the draft petition evaluation document/environmental impact state (PED/EIS) prepared to evaluate it, Wyoming EQC rejected the petitioners' appeal. Wyoming EQC's upholding of Wyoming DEQ's decision was not based on the substance of the appeal but, rather, on the fact that the petitioners did not file the appeal within the required 60-day time period after Wyoming DEQ's rejection decision. Wyoming EQC's decision had no effect on OSM's processing of the petition.

In order to include the Federal parcels as part of the petition area, the petitioners submitted a supplement to their petition to Wyoming DEQ. Wyoming DEQ forwarded a copy of this supplement to OSM, which is responsible for evaluating petitions addressing Federal lands. OSM received this copy on September 27, 1982.

On February 8, 1983, OSM received a letter from the Bureau of Land Management (BLM), Wyoming State Office, containing that agency's recommendations on the Red Rim unsuitability petition (appendix I). BLM recommended that the petition be rejected, because (1) the petitioners had presented no new evidence that was not considered in BLM's final land-use planning decision for the proposed Red Rim coal lease tract and (2) BLM's current general and specific land-use planning decisions for the tract, as well as stipulations BLM would append to any coal lease issued for it, provide or would provide sufficient protection to the resources of the petition area to negate the concerns and allegations of the petition. OSM considered BLM's recommendation but, at the Secretary of the Interior's direction, decided to work cooperatively with Wyoming DEQ to process the private- and Federal-lands petitions.

Taylor Lawrence, who owns the majority of the private land, and leases the majority of the Federal grazing allotments, within the petition area, filed an intervention petition to the Red Rim unsuitability petition with Wyoming EQC on March 4, 1983, and with OSM on March 8, 1983.

On June 3, 1983, OSM made a decision, with concurrence by Wyoming DEQ, to prepare a combined PED/EIS evaluating the Red Rim unsuitability petition in compliance with the requirements of Section 102(2)(C) of the National Environmental Policy Act of 1969 (NEPA).

On October 19, 1983, the draft PED/EIS was mailed to all parties who had expressed an interest in the petition.

On December 1, 1984, Rocky Mountain Energy Company, which owns the coal underlying the private lands within the petition area, filed an intervention petition with Wyoming EQC and OSM.

OSM and Wyoming EQC held a joint public hearing on the petition and draft PED/EIS on January 23 and 24, 1985, in Rawlins, Wyoming.

On May 22, 1985, Wyoming EQC decided by a vote of four to three not to designate any of the private lands within the petition area as unsuitable for surface coal mining operations. In consequence, Wyoming DEQ withdrew from participating in the preparation of this final PED/EIS, for which OSM then assumed full responsibility.

C. DESCRIPTION OF THE FEDERAL ACTIONS

For Federal lands, the Secretary of the Interior is required to make a decision to grant or deny the Red Rim petition. (As part of its regulatory reform effort, OSM has revised its regulations at 30 CFR 760 through 769. However, this petition is being processed in accordance with the State and Federal regulations that were in effect when the petition was filed.)

The alternative decisions available to the Secretary range from designating all lands in the entire petition area as unsuitable for all or certain types of surface mining operations to not designating any of the lands in the area as unsuitable. The Secretary also has the option of designating only parts of the area as unsuitable for all or certain types of surface coal mining operations. (For the purposes of this document, "surface coal mining operations" means either those activities conducted in connection with a surface coal mine or the surface effects of an underground coal mine. See Section 701(28)(A) of SMCRA for the definition of "surface coal mining operations.") In its mitigation requirements for the proposed Red Rim coal lease tract, BLM has stipulated that the successful lessee of the tract not create any surface disturbance (except for telephone lines or powerlines, if approved by BLM) within the Separation Creek riparian zone, the golden eagle nest buffer zone, and the pronghorn no surface occupancy areas. Therefore, these areas, developed by BLM during its land-use planning process for the Red Rim tract, would not be mined under any alternative that would otherwise allow surface coal mining operations on all or a part of the petition area (alternatives B, C, and D). Specifically, the possible alternative decisions that the Secretary may make on the Red Rim unsuitability petition are:

Alternative A: Designate the entire petition area as unsuitable for surface coal mining operations.--Implementation of this alternative would preclude any surface coal mining operations within the petition area and any future Federal coal leasing for mining operations unless such designation were terminated by petition.

Alternative B: Not designate any of the petition area as unsuitable for surface coal mining operations.--For the purposes of the environmental-impact analyses presented in this PED/EIS, OSM has assumed that, if this alternative were adopted, mining would occur. However, implementation of this alternative would not necessarily mean that the petition area would be mined for coal. For mining to take place at Red Rim, OSM (in accordance with SMCRA and NEPA) and Wyoming DEQ (in accordance with WEQA) would have to approve a permit application and issue a permit to mine coal to a permit applicant for the area. In addition, the Secretary of the Interior (in accordance with the Mineral Leasing Act of 1920, as amended) would have to approve a mining plan. (Obviously, prior to OSM, Wyoming DEQ, and the Secretary taking any of these actions, BLM would have to lease the proposed Red Rim coal lease tract and application would have to be made to mine it.) Any application for a permit and mining plan to mine Federal coal on Red Rim would be reviewed with assistance from BLM, the Federal surface- and coal-managing agency, and would consider previous environmental analyses of the area (see section E of this chapter for a discussion of the BLM coal leasing and land-use planning environmental analyses that have been performed for the Red Rim area), as well as comments from the public. This alternative to not designate any of the petition area as unsuitable for surface coal mining operations comprises three subalternatives (alternatives B1, B2, and B3) that correspond to possible requirements to reclaim Red Rim under each of three reclamation scenarios, which OSM developed to encompass the full range of possible approaches to reclamation of the area. It also comprises a fourth subalternative (alternative B4) whereby, before it would be allowed to mine the south portion of the Red Rim coal lease tract, the lessee of the tract would be required to demonstrate that pronghorn critical winter range in the north portion of the tract could be successfully reclaimed:

Alternative B1: Not designate as unsuitable for surface coal mining operations the entire petition area on the basis that the area, including all pronghorn critical winter range within it, would be reclaimed to closely approach its premining condition.--This alternative is analyzed as reclamation scenario 1 in chapter IV.

Alternative B2: Not designate as unsuitable for surface coal mining operations the entire petition area on the basis that half of the area would be reclaimed to closely approach its premining condition; the other half would be reclaimed using standard reclamation practices to a multiple-use native grassland for livestock grazing and wildlife habitat.--This alternative is analyzed as reclamation scenario 2 in chapter IV.

Alternative B3: Not designate as unsuitable for surface coal mining operations the entire petition area on the basis that the area, including all pronghorn critical winter range within it, would be reclaimed using standard reclamation practices to a multiple-use native grassland for livestock grazing and wildlife habitat.--This alternative is analyzed as reclamation scenario 3 in chapter IV.

Alternative B4: Not designate as unsuitable for surface coal mining operations the entire petition area but require the lessee to demonstrate the success of reclamation of the pronghorn critical winter range in the north portion of the Red Rim coal lease tract before allowing the south portion of the tract to be mined.--Implementation of this alternative would preclude any surface coal mining operations within the south portion of the Red Rim coal lease tract until it could be demonstrated that the north portion of the tract could be successfully reclaimed. The Council on Environmental Quality's regulations for implementing procedural provisions of NEPA require an agency preparing an EIS to identify which of the alternative Federal actions addressed in the EIS constitutes its preferred alternative action (40 CFR 1502.14(e)). OSM's preferred alternative for the Red Rim unsuitability petition is alternative B4.

Alternative C: Designate parts of the petition area as unsuitable for surface coal mining operations.--Implementation of this alternative would preclude any surface coal mining operations only on certain parts of the petition area based on one of two possible criteria: (1) the Secretary would find that surface coal mining operations would affect or significantly damage certain areas comprising fragile lands or important natural systems (alternatives C1a, C1b, and C1c) or (2) he would find that these operations would affect certain areas that could not be technologically and economically reclaimed (alternative C2):

Alternative C1: Designate as unsuitable for all surface coal mining operations those parts of the petition area in which operations would result in significant damage to important natural systems.

Alternative C1a: Designate as unsuitable for all surface coal mining operations Irwin and others' (1984) Separation Creek and Red Rim study subareas.

Alternative C1b: Designate as unsuitable for all surface coal mining operations the pronghorn critical winter range delineated by Wyoming GFD.

Alternative C1c: Designate as unsuitable for all surface coal mining operations that portion of the pronghorn critical winter range recommended for designation by Wyoming GFD.

Alternative C2: Designate as unsuitable for all surface coal mining operations those parts of the petition area on which reclamation is not technologically and economically feasible.

Alternative D: Designate the entire petition area as unsuitable for surface coal mining, but allow underground coal mining.--Implementation of this alternative would preclude surface coal mining within the petition area, but would allow underground mining if such mining resulted in no significant surface effects. BLM has determined that the proposed Red Rim coal lease tract has moderate potential for subsurface mining. However, underground mining does not appear likely in the foreseeable future, because (1) the expense of mining the subbituminous coal resources at Red Rim would not be sufficiently offset by profits from that venture (only 50 to 55 percent of the in-place coal resource could be mined); (2) significant health and safety problems could result from mining these particular steeply dipping multiple seams of coal; and (3) underground mining these coal seams could cause extensive surface subsidence, which could be environmentally unacceptable to OSM and BLM. Therefore, no specific underground mining alternative was considered in this PED/EIS.

Alternative E: No action.--Because this document not only evaluates the Red Rim petition (by way of a PED) but constitutes an EIS, NEPA mandates that it address a "no-action alternative" (40 CFR 1502.14(d)), whereby the Secretary would make no findings with respect to the petition. However, because the Department of the Interior is required by Section 522 of SMCRA to issue a decision on the complete petition it has received, implementing the no-action alternative for the Red Rim petition would not be reasonable. Because the impacts to the human environment of implementing the no-action alternative would be the same as those of not designating any of the petition area as unsuitable for surface coal mining operations (alternative B), for the purpose of the PED/EIS these alternatives are considered equivalent. Therefore, although the no-action alternative is included as alternative E in this PED/EIS, it is not analyzed further here.

D. PUBLIC RECORD

OSM has maintained a record of the progress of the Red Rim petition evaluation process. Included in this record are the data specifically generated for this document, the Red Rim unsuitability petition, affidavits in support of the petition, a transcript of the public hearing, and other petition-related documents. The record may be reviewed by the public and any portion of it copied at a reasonable charge; it is available at the OSM Western Technical Center Office, Brooks Towers, 1020 -15th Street, Denver, Colorado 80202; at the Wyoming DEQ Office, Herschler Building, 122 West 25th Street, Cheyenne, Wyoming 82002; at the BLM District Office, 1300 North 3d Street, Rawlins, Wyoming 82301; and at the Office of the County Clerk, Carbon County Courthouse, Fifth and Spruce Streets, Rawlins, Wyoming 82301.

E. SUMMARY OF MAJOR IMPACTS AND CONCLUSIONS

The major impacts to the environment of Red Rim should mining occur there, and the conclusions OSM has reached regarding these impacts, are as follows:

Wildlife.--Mining the coal underlying Red Rim's pronghorn critical winter range by surface-mining methods would have significant adverse impacts on the pronghorn of the Baggs Herd, which depends upon the range for survival during severe winter weather.

OSM estimates that, during a severe winter, pronghorn mortality owing directly to habitat loss due to mining could range from 53 to 1,205 (0.7 to 17 percent of the herd), depending upon the extent of unreclaimed mining disturbance at the time the severe winter occurred. Assuming that a severe winter occurred once every 5 years, approximately 6,800 pronghorn could die over the life of the mine as the direct result of habitat loss. Several other factors could account for considerable additional pronghorn losses over the short term. During mining and reclamation, pronghorn would be restricted from portions of the critical winter range by fences, spoil piles, pits, and other mining-related disturbances and facilities. During and following severe winter snowstorms, pronghorn access to the vital shelter and exposed forage that these areas normally provide would be restricted or curtailed. In consequence, individual pronghorn would be increasingly exposed to the elements; they would be forced to expend considerable energy to attempt to move around barriers or to locate shelter and accessible forage elsewhere. Exposure and overexertion, together with all other factors affecting the survival of pronghorn, would both increase the mortality and decrease the reproductive capability of the pronghorn population. Some fences erected in conjunction with mining could be designed to permit pronghorn passage. However, to ensure the successful reestablishment of vegetation, fencing surrounding revegetated mined areas would have to be designed to exclude pronghorn. These fences could kill pronghorn that became entangled while attempting to cross them; they could also confuse and entrap pronghorn driven into or cornered by them during severe snowstorms. The influx and increased activity of people in the Red Rim area owing to mining would also affect pronghorn adversely. Poaching, road kills, and harassment would increase. In light of these factors, mining and reclamation would result in significant, short-term adverse impacts to the herd.

In addition to direct and indirect impacts caused by the mining operation during mining and reclamation, long-term alteration of the topography and vegetation patterns, reduction of vegetation densities and diversity, and reduction of forage available to pronghorn would result if the petition area were reclaimed to minimally meet the standards of the Wyoming State program for regulating surface coal mining operations. The combined effect of these alternations and reductions would be to reduce the carrying capacity of the Red Rim pronghorn critical winter range. This reduction in carrying capacity could constitute a significant, long-term impact to the Baggs Herd.

Topography.--Topography is an important component of the pronghorn critical winter range: it has directly influenced the soils and vegetation communities that have formed in and colonized the petition area; it determines the snow-drifting patterns on the area; and, in combination with other factors, it renders the Red Rim critical winter range capable of supporting large numbers of wintering pronghorn. It is conceivable that Red Rim could be reclaimed to a topographic configuration different from its existing one without reducing the carrying capacity of the area for pronghorn or altering its value as pronghorn shelter during severe winter storms. However, no such configuration has been identified at this stage, prior to the leasing of the Federal coal underlying the tract and before the development of a site-specific mining plan. If the topography of the mined area could be reclaimed to closely approach its premining condition, and if the soils and vegetation of the area could likewise be reclaimed, the premining carrying capacity of the pronghorn critical winter range would be very nearly restored. However, analyses indicate that certain hillslopes could not be returned to their premining steepness using standard reclamation practices (those reclamation techniques that both minimally comply with the requirements of the Wyoming State program and are currently being used in the State to reclaim areas disturbed by surface coal mining operations). These hillslopes, which are supported by indurated bedrock, would be unstable and subject to landsliding; they would have to be stabilized by means of structures not normally used in reclamation. In addition, excessive fluvial erosion (principally in rills and gullies) would likely occur on the steeper hillslopes. For these reasons, steeper slopes in the mined area would probably be very difficult to reclaim to closely approach their premining condition; because of this difficulty, these slopes might not be so reclaimed. In consequence, the overall carrying capacity of the critial winter range could be reduced. Reclaiming the topography using standard reclamation practices to the "approximate orginal contour" condition required by regulation appears to be quite feasible, but this type of reclamation could reduce the carrying capacity of the critical winter range even further.

Vegetation.--Revegetation of the mined area with sagebrush, which is the principal component of the pronghorn winter diet, would be difficult owing to low precipitation, dessicating winds, and limited soils suitable for replanting with sagebrush in the area. For revegetation with sagebrush to be successful, it would have to be undertaken using a combination of planting methods, including transplanting shrubs already growing in the area by tree spade, setting containerized tubelings, and seeding. Vegetation patterns, densities, and diversity would not be restored in the short term. Revegetation of the mined area using standard reclamation practices would result in long-term reductions in the amount of forage available to pronghorn and, therefore, in potentially significant, long-term impacts to the Baggs Herd. Long-term productivity would depend largely on range-management practices employed by BLM and private landowners and on Wyoming GFD's management of the Baggs Herd.

Land use.--Currently, BLM classifies the petition area as multiple-use native grassland for livestock grazing, wildlife habitat, and recreation. Although the mined area would retain this classification even after reclamation were completed, reclaiming the mined area using standard reclamation practices (e.g., establishing more grass and forb cover but fewer shrubs than now exist) would render it more suitable for livestock grazing and less suitable for wildlife habitat. This type of reclamation would reduce the amount of forage available to pronghorn at Red Rim over the long term; significant adverse impacts to the Baggs Herd could result.

Reclaimability.--Regarding the technological feasibility of reclamation, OSM has identified no part of the petition area that could not be reclaimed using standard reclamation practices. Reclamation of the petition area to a multiple-use native grassland for livestock grazing and wildlife habitat would be difficult, owing to severe climatic and environmental conditions in the area, but achievable.

The petitioners allege that the topography of the mined area must be precisely restored ("microcontoured") and that very high densities of shrubs must be promptly reestablished on the area. To reclaim the petition area to closely approach its premining condition would be very difficult, but the magnitude of difficulty would differ from feature to feature within the area. In general, the steep slopes now supported by indurated bedrock would be most difficult to reconstruct. Although the probability for failure of this type of reclamation over the entire petition area would be much higher than the probability for failure of reclamation using standard reclamation practices, analyses performed by OSM do not conclusively show that this type of reclamation is technologically infeasible.

Regarding the economic feasibility of reclamation, the costs to reclaim the petition area would be comparable with costs to reclaim other surface coal mines in Wyoming. Therefore, the cost of reclaiming Red Rim would not be prohibitively high and reclamation of the area would not be economically infeasible.

Socioeconomics.--Mining would directly and indirectly create jobs for the residents of Rawlins and Carbon County and would generate local property taxes, severence taxes, and Federal royalties. With or without the mine, the population of Carbon County would decline slightly from 1990 through 1995. With the mine, the growth rate of Rawlins would increase slightly each year from 1993 to 2000. Without the mine, the growth rate would decline slightly each year during this period. Although a mine would benefit Rawlins and Carbon County, the stability of the local economy and population is not solely dependent upon the development of Red Rim.

Economics of coal resources.--The loss of petition-area coal, resulting from designating the area as unsuitable for surface coal mining operations, would not cause a significant impact on regional coal supplies; other mines in the region could supply the same market that coal from the petition area would supply at costs that would probably be comparable.

F. CONTROVERSIAL ISSUES

Certain issues relating to the Red Rim unsuitability petition have generated considerable public controversy. These include the extent to which mining the Red Rim pronghorn critical winter range would affect the Baggs Herd; how technologically and economically feasible it would be to reclaim the topography, vegetation, and soils on the range; the potential postmining increase of the area's suitability for livestock grazing at the expense of its suitability as wildlife habitat; and whether or not a mine at Red Rim would be essential to maintaining the local economy.

In 1982, rancher Taylor Lawrence (owner of the majority of the private surface within the petition area) erected a 28-mile-long fence that prevents pronghorn from reaching portions of the Red Rim critical winter range. In April 1985, in response to affidavits filed by the petitioners requesting enforcement of the Unlawful Inclosure Act of 1885, the U.S. Attorney filed a complaint in Federal court against Mr. Lawrence asking that this fence be declared illegal and that an injunction permanently removing it be issued. The affidavits alleged that the fence unlawfully enclosed about 10,000 acres of Federal land. Although the fence is significant and controversial, it is not at issue in the National Wildlife Federation/Wyoming Wildlife Federation petition to designate Red Rim unsuitable for surface coal mining operations. Therefore, the issues of concern relative to the fence are not within the scope of this PED/EIS and are not addressed here.

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CHAPTER I

INTRODUCTION

The Office of Surface Mining Reclamation and Enforcement (OSM) has prepared this petition evaluation document/environmental impact statement (PED/EIS) in accordance with Section 522(d) of the Surface Mining Control and Reclamation Act (SMCRA) and Section 102(2)(C) of the National Environmental Policy Act (NEPA). It contains detailed statements on (1) the potential coal resources of the Red Rim, Wyoming, area, (2) the demand for those coal resources, and (3) the impacts to the human environment, the economy, and the supply of coal of implementing alternative decisions regarding the National Wildlife Federation/Wyoming Wildlife Federation unsuitability petition.

A. SCOPE OF EVALUATION

Any person who has an interest which is or may be adversely affected has the right to petition the regulatory authority to have an area designated as unsuitable for surface coal mining operations. The regulatory authority responsible for administering surface coal mining operations in the area to which the petition pertains shall designate that area as unsuitable if it determines that reclamation of the area, pursuant to the requirements of SMCRA, is not technologically and economically feasible (Section 522(a)(2) of SMCRA). The regulatory authority may designate the area as unsuitable if surface coal mining operations would (1) be incompatible with existing State or local land-use plans or programs (Section 522(a)(3)(A) of SMCRA); or (2) affect fragile or historic lands, in which such operations could result in significant damage to important historic, cultural, scientific, and esthetic values and natural systems (Section 522(a)(3)(B) of SMCRA); or (3) affect renewable-resource lands, in which such operations could result in a substantial loss or reduction of long-range productivity of water supply or of food or fiber products, and such lands to include aquifers and aquifer recharge areas (Section 522(a)(3)(C) of SMCRA); or (4) affect natural-hazard lands, in which such operations could substantially endanger life or property, such lands to include areas subject to flooding and areas of unstable geology (Section 522(a)(3)(D) of SMCRA). Any petition requesting such a designation must contain the location and size of the petition area; allegations of fact and supporting evidence which would tend to support these allegations; a description of how mining may adversely affect people, land, air, water, or other resources; the petitioner's name, address, and telephone number; and an identification of the petitioner's interest that is or may be adversely affected (30 CFR 769.13).

The report of the Committee on Interior and Insular Affairs, H. R. Report No. 95-218, April 22, 1977, discusses the purpose of the unsuitability designation process:

> "The process for designation of land areas as unsuitable for surface coal mining is also premised on the notion that successful management of surface mining depends, in large part, on the application of rational planning principles. While coal surface mining may be an important and productive use of land, it also involves certain hazards and is but one of many alternative land

> uses. In some circumstances, therefore, coal surface mining should give way to competing uses of higher benefit. * * *.
>
> "The committee wishes to emphasize that this section does not require the designation of areas as unsuitable for surface mining other than where it is demonstrated that reclamation of an area is not physically or economically feasible under the standards of the act. The other criteria for designation, which relate to general planning and environmental concerns, are discretionary and thus the State could determine that no lands should be designated thereunder, or, on the other hand, could prohibit all or some types of surface mining entirely. In addition to the discretionary designation criteria, the designation process includes other elements of flexibility. For example, the designation of unsuitability will not necessarily result in a prohibition of mining. The designation can merely limit specific types of mining and thus the coal resource may still be extracted by a mining technology which would protect the values upon which the designation is premised. In addition, after an area is designated, coal development is not totally precluded as exploration for coal may continue. Moreover, any interested person may petition for termination of a designation.
>
> "The designation process is not intended to be used as a process to close existing mine operations, although the area in which such operations are located may be designated with respect to future mines. * * *.
>
> * * * * * * *
>
> "It should be noted that the designation process is structured to be applied on an area basis, rather than a site-by-site determination which presents issues more appropriately addressed in the permit application process. The committee believes that the area-by-area approach of Section 522 thus serves the industry since such a process may, in advance of application, identify lands which are either not open to surface mining or where surface mining is subject to restrictions."

Section 522 of SMCRA authorizes the Secretary of the Interior to designate lands unsuitable for all or certain types of surface coal mining because of "competing uses of higher benefits." The Bureau of Land Management (BLM) has completed comprehensive land-use planning for Federal lands in the Red Rim area. A discussion of BLM's land-use planning decisions is included in section E of this chapter.

It should be clearly understood that a decision to not designate all or any part of a petition area as unsuitable for all or certain types of surface coal mining operations would not mean that such lands have been, conversely, determined as suitable for such operations. The designation process as conceived by Congress is not intended to usurp the permitting and mining-plan approval processes, which may also preclude or otherwise control such operations. For mining to take place in an area designated as not unsuitable for surface coal mining operations, the regulatory authority would have to approve a permit application and issue a permit to mine coal to a permit applicant for the area.

When an area is designated as unsuitable for surface coal mining operations, any person may petition to have such designation terminated (30 CFR 764.13(c) and 769.13(b)). The petition to terminate must include allegations, with supporting evidence, which furnish information additional to that contained in the record of proceedings by which the area was designated as unsuitable.

In compliance with SMCRA and NEPA respectively, this Red Rim PED/EIS combines an evaluation of the allegations and supporting evidence contained in National Wildlife Federation/Wyoming Wildlife Federation's petition, which requests that Federal and non-Federal lands in the Red Rim area be designated as unsuitable for surface coal mining operations, with an environmental impact statement of the possible effects on the environment of the petition area that would result from any Federal and/or State decision to grant, partially or conditionally grant, or deny the petition. OSM has prepared this evaluation and statement as one document (a PED/EIS) to avoid duplication and to reduce paperwork.

The fence that rancher Taylor Lawrence (owner of the majority of the private surface within the petition area) erected on the Red Rim petition area is not at issue in the current unsuitability petition. The fence prevents pronghorn from entering portions of the pronghorn critical winter range within the petition area. It became a point of much local and national newspaper and television coverage during the severe winter of 1983-84. In April 1985, in response to affadavits filed by the petitioners requesting enforcement of the Unlawful Inclosure Act of 1885, the U.S. Attorney filed a complaint in Federal court against Mr. Lawrence asking that this fence be declared illegal and that an injunction permanently removing it be issued. The affadavits alleged that the fence unlawfully enclosed about 10,000 acres of Federal land. Although the fence is significant and controversial, it is an issue separate from the National Wildlife Federation/Wyoming Wildlife Federation petition to designate areas unsuitable for surface coal mining operations. Therefore, the issues of concern relative to the fence are not within the scope of this PED/EIS and are not addressed here.

B. PETITION EVENTS AND CRITERIA

Events.--The Red Rim petition (appendix A) was submitted to the Wyoming Department of Environmental Quality (DEQ) on May 10, 1982, by the National Wildlife Federation and the Wyoming Wildlife Federation. Pursuant to Chapter XVIII, Section 1(5), Wyoming DEQ, Land Quality Division Rules and Regulations, petition item 2, "Identification of Petitioners' Interest Which May be Adversely Affected," was declared incomplete by Wyoming DEQ (Wyoming Department of Environmental Quality, written communication, June 2, 1982; see appendix B). In addition, pursuant to Sections 35-11-103(e)(i), 402(a)(i), (ii), and (iv), 406 (b), (b)(i), and (b)(ii), and 415(b)(v) of the Wyoming Environmental Quality Act (WEQA), petition allegation 2 (alleging that reclamation of the petition area to wildlife habitat, as mandated by SMCRA and WEQA, is not feasible) was denied as frivolous by Wyoming DEQ. Wyoming DEQ's rationale for its decision regarding petition allegation 2 was that "neither Federal nor State law requires that the postmining land use for the 'Red Rim' area be wildlife habitat" (Wyoming Department of Environmental Quality, written communication, June 2, 1982; see appendix B).

A supplement to the petition was submitted to Wyoming DEQ on July 6, 1982, in response to both decisions (National Wildlife Federation, written communication; see appendix B). Wyoming DEQ considered this supplement to adequately address and satisfy its concerns regarding petition item 2; however, the information submitted did not alter Wyoming DEQ's decision to deny petition allegation 2 as frivolous. Regarding petition allegation 2, Wyoming DEQ upheld its Administrator's original argument, which was that "Although the regulatory requirements appear to favor restoration of wildlife habitat, considerable discretion is vested with the Administrator to approve an alternative postmining land use if wildlife habitat restoration is not possible or if private landowners request an alternative land use which would preclude use as wildlife habitat. See Chapter IV, Section 2.a.(2), Land Quality Division Rules and Regulations. Therefore, inasmuch as wildlife habitat is not a mandatory postmining land use, I must deny that part of the petition alleging that reclamation as required by the Act (WEQA) is not feasible" (Wyoming Department of Environmental Quality, written communication, June 2, 1982; see appendix B). (On October 12, 1982, the petitioners filed an appeal with the Wyoming Environmental Quality Council (EQC) to reverse Wyoming DEQ's decision to reject petition allegation 2.)

Moreover, Wyoming DEQ's Administrator reasoned that, pursuant to Chapter XVIII, Section 1(2), Wyoming DEQ, Land Quality Division Rules and Regulations, a petition whose allegations rely on the definition of "fragile lands" should not be considered complete until the petitioners first "identify a geographic area containing the important resource that could be damaged by the coal mining operation" (Wyoming Department of Environmental Quality, written communication, July 26, 1982; see appendix B). Wyoming DEQ considered that the petitioners did not specifically define such a geographic area. Rather, the petitioners identified certain parcels of land and failed to identify certain other (Federal) parcels interspersed among them. Because the petition did not identify the Federal parcels of land, Wyoming DEQ's Administrator informed the petitioners that "I cannot address the designation process under W.S. 35-11-425, which is essentially a land use planning process, without a land area. * * *. Although authorized, I am reluctant to deny your petition as incomplete at this time. I believe the petition process is a valid means of increasing public participation as required by the State Program and federal law. To give the petition process some viability on intermingled federal and nonfederal lands, the Governor is requesting Secretary Watt to bring the intermingled federal lands within the Red Rim area into the State's designation process" (Wyoming Department of Environmental Quality, written communication, July 26, 1982; see appendix B).

However, before the Secretary of the Interior was able to respond to the Governor's request, the petitioners supplemented their petition to include the Federal parcels as part of the petition area. This supplement was submitted to Wyoming DEQ, which then forwarded a copy of it to OSM. OSM, which is responsible for evaluating petitions addressing Federal lands, received this copy on September 27, 1982.

On February 8, 1983, OSM received a recommendation letter from BLM, Wyoming State Office, on the Red Rim unsuitability petition (appendix I). BLM recommended that the petition be rejected, because (1) the petitioners had presented no evidence that was not considered in BLM's final land-use planning decision for the proposed Red Rim coal lease tract and (2) BLM's current general and specific land-use planning decisions for the tract, as well as stipulations BLM would append to any coal lease issued for it, provide or would provide sufficient protection to the resources of the petition area to negate the concerns and allegations of the petition. OSM considered BLM's recommendation but, at the Secretary of the Interior's direction, decided to work cooperatively with Wyoming DEQ to process the private- and Federal-lands petitions.

An intervention petition to the Red Rim unsuitability petition was filed with Wyoming EQC on March 4, 1983, and with OSM on March 8, 1983, by Taylor Lawrence, who owns the majority of the private land, and leases the majority of the Federal grazing allotments, within the petition area. Mr. Lawrence's intervention petition described the history of the Red Rim area, surface mining's effect of fragile lands in Red Rim, why the reclamation of Red Rim is technologically and economically feasible, and the effect of an unsuitability designation upon the economy. The major points of Taylor Lawrence's intervention petition are summarized as follows.

With regard to surface mining's effect on fragile lands in Red Rim, Mr. Lawrence's position is that:

> "the 'natural system' involved, the regional pronghorn antelope herd, would not sustain significant damage due to the following reasons: (1) surface mining of the Red Rim tract will not cause long-term damage to the herd; (2) only a small portion of the Baggs herd would be affected by the mining and this herd will ultimately reestablish itself from the remaining Baggs herd; (3) only a small acreage of the total winter habitat will be disturbed; (4) not all of the acreage will be disturbed at one time, i.e. there will be continuous mining and reclamation which will occur throughout the lifetime of the mine; (5) the effect on the pronghorn antelope can be controlled through the Wyoming Game and Fish Department's increasing and ultimately decreasing the legal harvest on the Baggs pronghorn antelope herd; and (6) the BLM, through its land use planning stipulations including the 'no surface occupancy stipulation' and the 'antelope mitigation stipulation', has mitigated any adverse effects on the pronghorn antelope" (Lawrence, 1983, p. 11-12).

With regard to the economic and technical feasibility of mining Red Rim, Mr. Lawrence's intervention petition states that (1) a Rocky Mountain Energy Company (RME) report ("Shrub Establishment for Reclamation of Wildlife Habitat on Mined Land in Southern Wyoming--An Overview") demonstrates that past and current research strongly supports the potential for successful establishment of shrubs on mined areas in the Red Rim; (2) the petition does not present any evidence regarding the market price of coal and coal-production costs to support its allegation that mining is economically infeasible; and (3) if it is truly economically infeasible to mine Red Rim and meet the reclamation requirements of the Federal and State governments, the Red Rim tract will not be bid upon by mining companies at the lease sale.

With regard to the effect of an unsuitability designation on the economy, Mr. Lawrence's intervention petition states that (1) the expenditure of over $61,000,000 in the initial mine-constrution and equipment-installation phase would have a significant impact on both the Federal and local economy and would be an impetus to helping the State, local, and national economies recover from the current economic recession; (2) a mine would decrease unemployment in Carbon County;

(3) the Carbon County School District in Rawlins, Wyoming, has adequate capital improvements and staff to accommodate the mining employees' families; and (4) the city of Rawlins could easily accommodate the increase in housing demands caused by surface mining of the Red Rim tract.

OSM received a comment letter from the petitioner (National Wildlife Federation) regarding Taylor Lawrence's intervention petition on April 18, 1983. Wyoming EQC received the same letter on April 19, 1983. Owing to their length, this intervention petition and the petitioners' comment letter have not been reproduced in an appendix to this PED/EIS; the intervention petition and the comment letter are available for review by all interested persons at any of the public record depositories listed in the "Summary."

On June 3, 1983, OSM made a decision, with concurrence by Wyoming DEQ, to prepare a combined petition evaluation document and environmental impact statement (PED/EIS) that complies with the requirements of Section 102(2)(C) of NEPA. As a result, the preliminary draft PED which was being prepared was revised into a combined draft PED/EIS. A notice of intent to prepare a draft PED/EIS, including a request for public participation in the determination of the scope of the issues and in the identification of significant issues, was published in the June 29, 1983, Federal Register (48 F.R. 29961), and in the June 30, 1983, Rawlins Daily Times, and the July 2, 1983, Casper Star-Tribune newspapers. OSM received two comment letters by the end of the scoping period on July 29, 1983. Based on the comments in one of these letters, OSM and Wyoming DEQ modified the alternatives that the notice of intent had stated would be addressed in the draft PED/EIS; they considered the comments in the other letter, which discussed the current socioeconomic conditions in Rawlins, Wyoming, throughout preparation of the PED/EIS. All comments on the petition in the Red Rim public record (the intervention petition, the petitioners' response to the intervention petition, and all comments received in response to the notice of acceptance of a complete petition (48 F.R. 29961)) were used in determining the scope of the PED/EIS.

In accordance with Section 522 of SMCRA, Section 35-11-425(a) of WEQA, and Section 102(2)(C) of NEPA, a public hearing on the Red Rim petition and the draft PED/EIS was scheduled for December 6, 1983, in Rawlins, Wyoming. On October 20, 1983, notice of the hearing was published in the Federal Register; in November 1983, notice was published in the Rawlins Daily Times and the Casper Star-Tribune newspapers. Persons who expressed in writing an interest in the petition were also notified individually of the hearing and were forwarded a copy of the draft PED/EIS.

On December 1, 1983, a prehearing conference was held among all parties to the petition (OSM, Wyoming EQC, the petitioners, Taylor Lawrence, and RME) to discuss the procedures for the hearing. At that meeting, RME submitted an intervention petition to Wyoming EQC and OSM.

RME's intervention petition consists of copies of (1) a legal notice of intervention; (2) a July 29, 1983, letter from RME to OSM that contains comments submitted during the scoping period for the PED/EIS; (3) a February 4, 1983, letter from RME to OSM that summarizes the available environmental background data for Red Rim; (4) an RME report entitled "Potential Mining Impacts to Wildlife in the Red Rim/Chine Butte Lease Areas;" (5) a BLM document entitled "Analysis of Wildlife Impacts, Red Rim-China Butte;" (6) BLM's December 31, 1981, Federal Register notice of the final land-use planning decision for the proposed Red Rim coal lease tract; (7) a July 27, 1981, letter from Governor Herschler to the Wyoming State Director of BLM on Red Rim; and (8) an April 1983 RME draft report entitled "Red Rim Sagebrush Reclamation Study." Owing to its length, RME's intervention petition has not been reproduced in an appendix to this PED/EIS. The intervention petition is available for review by all interested persons at any of the public record depositories listed in the "Summary."

Summarizing the existing environmental reports for Red Rim, RME's February 4, 1983, letter to OSM states:

> "The best estimate is that Red Rim will lose carrying capacity for 128 antelope during the years of maximum disturbance. Average carrying capacity reduction calculated from mine start-up until final reclamation would be 5.7 percent of present Red Rim carrying capacity. Application of appropriate mitigation techniques could reduce this impact.
>
> "Reclaimed areas will have some value to antelope before they are fully reclaimed.
>
> "Mine disturbance will be 150 acres per year over the mine life of 25 years.
>
> "Potential mitigation methods include: reserving browse for antelope use, increasing the quality of undisturbed areas, improving access to winter ranges, providing supplemental feed during emergency situations, and educating mine employees.
>
> "Several shrub establishment techniques may be usable at Red Rim. These include: mature transplants, seedling transplants, and direct seeding.
>
> "Mature sagebrush plants can be successfully transplanted onto disturbed sites.
>
> "Reclamation potential of Red Rim soils range from very good to unsuitable based on this general survey.
>
> "Antelope use Red Rim during most winters.
>
> "During the deep snow year of 1979-80, most antelope left Red Rim and wintered on windswept ridges to the south and west.
>
> "Five alternative winter ranges were identified.
>
> "Antelope can move long distances during deep snow winters.
>
> "Many important browse species are overutilized by pronghorns at present population levels.
>
> "A highly digestible ration has been successfully tested on penned antelope. This could potentially be used as supplementary feed for antelope in critical winter conditions. Field delivery systems are now being tested."

On December 2, 1983, the petitioners and RME requested a continuance of the hearing until at least February 6, 1984. Wyoming EQC, with OSM concurrence, granted the request. The basis for the request was that these parties believed that such a continuance might allow them and Taylor Lawrence to reach a settlement that would result in the petitioners withdrawing their petition, making a hearing unnecessary. Owing to the ongoing negotiations among the petitioners and the two intervenors, OSM and Wyoming EQC decided to postpone the public hearing and to extend the comments period on the petition and draft PED/EIS until further notice. This decision was published in the Federal Register on January 4, 1984.

In early March 1984, the public hearing was rescheduled for April 9, 1984, in Rawlins, Wyoming. Notice of the rescheduling was published in the Federal Register on March 5, 1984. In addition, the close of comments date for the petition and draft PED/EIS was extended to April 20.

To allow additional time for negotiations by the parties to the petition and at Governor Herschler's request, Wyoming EQC decided to postpone the hearing indefinitely at its March 29, 1984, meeting. Notice of postponement of the hearing and indefinite extension of the public comment period was published in the April 4, 1984, Federal Register.

On July 10 and August 1, 1984, BLM, at the direction of the Assistant Secretary, Land and Minerals Management, Department of the Interior, scheduled and held meetings attended by Taylor Lawrence, RME, the petitioners, OSM, the Wyoming Game and Fish Department (GFD), and representatives from the Governor's Office. The meetings served as a forum for negotiations by the parties to the petition, but no settlement was reached as a result of them. Therefore, OSM and Wyoming EQC rescheduled the hearing for January 23 and 24, 1985, in Rawlins, Wyoming. Notice of the hearing, and of the extension of the comment period on the petition and draft PED/EIS until February 7, 1985, was published in the Federal Register on December 19, 1984. This same notice was published in the December 19 and 26, 1984, and January 16, 1985, Rawlins Daily Times and Casper Star-Tribune newspapers. Persons expressing in writing an interest in the petition were notified individually by mail of the hearing.

At the hearing, Wyoming EQC rejected the petitioners' October 12, 1982, appeal of Wyoming DEQ's rejection of allegation 2 of the petition. Wyoming EQC's upholding of Wyoming DEQ's decision was not based on the substance of the appeal but, rather, on the fact that the petitioners did not file the appeal within the required 60-day time period after Wyoming DEQ's rejection decision. Wyoming EQC's decision had no effect on OSM's processing of the petition. OSM had not previously rejected allegation 2; therefore, it continued to analyze that allegation.

On May 22, 1985, Wyoming EQC decided by a vote of four to three not to designate any of the private lands within the petition area as unsuitable for surface coal mining operations. In consequence, Wyoming DEQ withdrew from participating in the preparation of this final PED/EIS, for which OSM then assumed full responsibility.

Criteria.--Because no mining is currently proposed for the Red Rim petition area (i.e., no mining and reclamation permit application package for the area, containing site-specific data regarding it, has been submitted to OSM or to Wyoming DEQ), OSM based its evaluation of the petition allegations, in large part, on (1) a "Maximum Economic Recovery and Mining Methods" report, developed by the U.S. Geological Survey (USGS) in 1978 (U.S. Geological Survey, 1978), (2) a 1983 BLM coal-resource report developed by that agency specifically for this petition analysis (Stiles and Pitman, 1983), (3) a 1981 BLM tract profile and site-specific analysis document for the proposed Red Rim tract (Bureau of Land Management, 1981b), and (4) a 1978 preliminary plan for mining describing how the Red Rim tract would be mined (D. H. Emling Company, 1978). The three USGS and BLM reports were based in part upon information supplied by RME, which, together with Energy Development Company, developed the preliminary plan. OSM also considered the information contained in Taylor Lawrence's and RME's intervention petitions; all oral and written comments received from the petitioners, intervenors, and the public at the public hearing; other written comments on the petition and draft PED/EIS received during the comment period; and information regarding the progress of mining and reclamation at active coal mines in southcentral Wyoming.

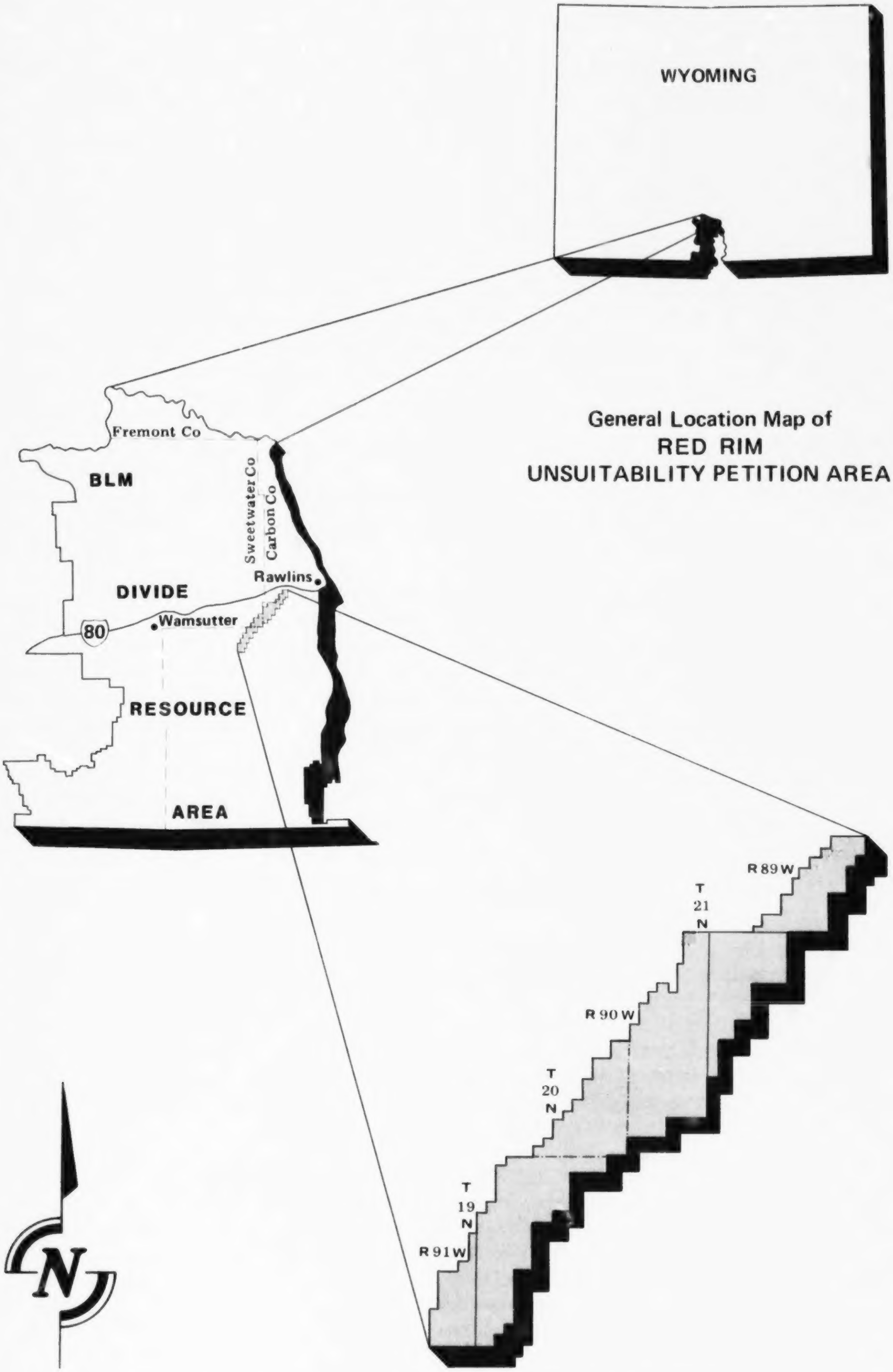
Impacts identified in this document are categorized as short-term when they would occur only during mining and reclamation (assumed to be about 40 to 45 years: 30 to 35 years for mining and reclamation operations and a minimum of 10 years for bond release after seeding, fertilizing, irrigation, or other work to ensure revegetation is completed) and as long-term when they would persist after mining and reclamation have been completed.

Land-area acreage figures cited in the petition for Federal (10,320 acres) and non-Federal (10,160 acres) lands were based on 1979 USGS acreage approximations for the proposed Red Rim coal lease tract. By researching title plats, OSM derived more accurate acreage approximations; these are given in appendix C. In general, the petition-area acreage totals for Federal (9,728.89 acres) and non-Federal (9,722.61 acres) lands used in this document are taken from estimates in appendix C; the petitioners' acreage totals are referred to in analyzing those specific petition allegations of which they are an integral part. In these latter cases, the discrepancies between the petitioners' and OSM's acreage approximations are clearly identified.

C. PETITION ALLEGATIONS

The 19,452 acres of land under allegation by the Red Rim petition and its supplements (fig. I-1) are located on a checkerboard pattern land-ownership area, comprising both Federal and private land (fig. I-2). The petition area consists of about 9,729 acres of Federal land, which approximately coincides with the proposed Red Rim Federal coal lease tract (plate 1, in pocket), and about 9,723 acres of privately owned land. The petition area is about 80 acres larger than the proposed lease tract, owing to differences in the boundaries in three locations in the northwest portion of the two areas.

The petitioners did not include as part of their petition area two parcels of land that are located within the boundaries of that area (fig. I-2). In preparing the petition, they apparently used a preliminary BLM delineation of the proposed lease tract which likewise did not include the two areas. BLM had determined the areas, which contain lands of important riparian value along Separation Creek, were unacceptable for surface coal mining operations. BLM's current proposed lease tract now includes these areas (plate 1), which are protected by a no surface occupancy stipulation (appendix J, plate 1).



General Location Map of
RED RIM
UNSUITABILITY PETITION AREA

WYOMING
Fremont Co
BLM
Sweetwater Co
Carbon Co
DIVIDE
Rawlins
80
Wamsutter
RESOURCE
AREA
R 89 W
T
21
N
R 90 W
T
20
N
T
19
N
R 91 W
N

Figure I-1.--Location of lands within the petition area.

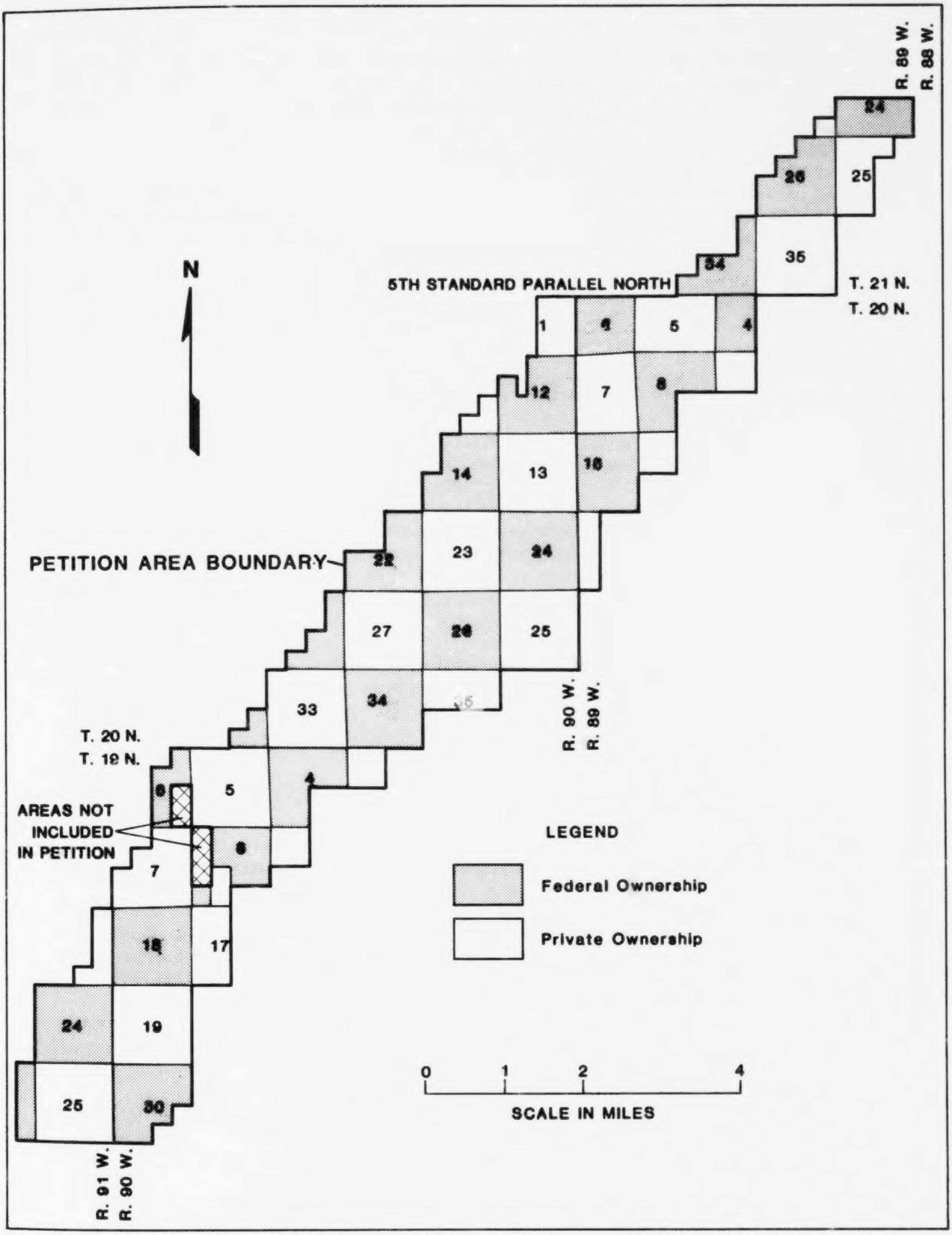

R. 89 W.
R. 88 W.
24
26
25
34
35
5TH STANDARD PARALLEL NORTH
T. 21 N.
T. 20 N.
N
1
6
5
4
12
7
8
14
13
18
PETITION AREA BOUNDARY
22
23
24
27
26
25
33
34
35
R. 90 W.
R. 89 W.
T. 20 N.
T. 19 N.
6
5
4
AREAS NOT INCLUDED IN PETITION
8
7
18
17
24
19
25
30
R. 91 W.
R. 90 W.
LEGEND
Federal Ownership
Private Ownership
0
1
2
4
SCALE IN MILES

Figure I-2.--Surface and coal ownership within the petition area.

The petition area contains no leased Federal coal. (Note that the Wyoming State Director of BLM has determined that Federal lands in the Red Rim tract are acceptable for coal development and for further consideration for leasing and that the Governor of Wyoming has also recommended that the tract be leased; however, no decision to lease the tract has yet been made.) Should the Federal tract be offered for lease bids, RME, a subsidiary of the Union Pacific Corporation and the owner of all coal underlying private lands within the petition area, could not enter a bid on the tract owing to its affiliation with the railroad (based on Department of the Interior Solicitor's Opinion M-36945, December 6, 1982).

The National Wildlife Federation/Wyoming Wildlife Federation's Red Rim petition alleges:

- Surface coal mining operations will adversely affect fragile land which is valuable habitat for pronghorn antelope.--In summary, the petitioners' statements in support of this allegation are:
    - Between 1,200 and 2,800 pronghorn winter on Red Rim. Wyoming Game and Fish Department (GFD) and BLM have designated 15,200 acres of land on Red Rim as "critical wildlife habitat" for a significant portion of the Baggs (pronghorn) Herd. Such habitat is in short supply and is the limiting resource for the entire herd unit.
    - The pronghorn critical winter range is the product of an unusual topographic-vegetative relationship. Specifically,
        - Strong winds at Red Rim blow snow clear from the uplifted land surfaces of the area, making forage available to pronghorn.
        - Narrow draws shelter pronghorn from winds.
        - The draws collect wind-driven snow, which gives them a high moisture microclimate and greater densities of forage relative to adjacent lands; this high-density forage (primarily big sagebrush) serves as an essential pronghorn winter food source.
    - A significant portion (9,120 acres by Wyoming GFD estimates) of the critical winter range would be mined. (The petitioners reference RME as indicating that 3,750 acres, including critical and non-critical pronghorn habitat, would be mined.)
    - Pronghorn populations would be adversely affected by the mining of critical winter range. Specifically,
        - Pronghorn would likely continue to use the traditional Red Rim critical winter range during mining operations; overcrowding on the unmined portions of the range would result in a large-scale nutritive deficiency over those portions and in subsequent reduced pronghorn survival and reproductive rates.

  - Herd loss would be directly proportional to habitat loss in severe winters (for example, if 35 percent of Red Rim were disturbed, 420 to 980 pronghorn would be lost).

  - There would be a cumulative loss of pronghorn progeny over the life of the mine.

- The reduction of Red Rim pronghorn populations would be a significant economic and scientific loss.

- Reclamation is not technologically and economically feasible under SMCRA (30 U.S.C. Sections 1201 et seq.).--In summary, the petitioners' statements in support of this allegation are:

  - Reclamation on Red Rim must, at a minimum, restore the affected land to a condition capable of supporting its highest premining uses, including critical winter range for pronghorn.

  - To preclude the loss of 1,200 to 2,800 pronghorn wintering on Red Rim, prompt restoration of critical winter range would be essential. Specifically,

    - Restoration of premining drainage patterns (to provide pronghorn shelter, increase moisture to vegetation, and furnish windswept areas on ridges) by "microcontouring" would be necessary. However,

      - Topographic "microcontouring" is not technologically and economically feasible.

        - Spoil "microcontoured" to premining configurations would be eroded owing to climatic conditions in the area (low precipitation, high winds, low temperatures) that make it difficult to revegetate. "Microcontoured" spoil would require substantial repair and maintenance until the area is successfully revegetated.

        - Topographic restoration by "microcontouring" would cost $6,000 to $7,500 per acre.

    - In order to avoid disastrous cumulative impacts and serious annual losses during critical winters to the pronghorn herd, the critical winter range should be promptly returned to optimum vegetation densities after disturbance. However,

      - RME's sagebrush transplanting/vegetation seeding program and an alternative "dryland sodding" method would not promptly reestablish vegetation; the costs to promptly reestablish vegetation densities to premining levels would be prohibitive.

        - RME's sagebrush transplanting/vegetation seeding program would not restore the current vegetation diversity and density. The quality of vegetation under such a plan would not be restored in less than 20 years at best, and possibly not for 40 years (Wyoming GFD estimate), after the termination of mining. The costs to immediately restore sagebrush densities to premining levels by transplanting individual sagebrush plants could be $100,000 to $120,000 per acre.

- Sagebrush transplanting by "dryland sodding" would kill sagebrush plants larger than 6 inches tall; surviving sagebrush would not reach premining heights (15 inches to 5 feet) for 15 years; costs for "dryland sodding" would range from $27,000 to $55,000 per acre.

D. PROPOSED ALTERNATIVE FEDERAL ACTIONS

This section describes and summarizes the possible alternative decisions that may be made on the Red Rim unsuitability petition. Analyses of the probable impacts of adopting each of these possible alternatives are presented in chapter V. The reasonable decision alternatives available to the Secretary of the Interior are shown in figure I-3. (Note that the Secretary of the Interior has delegated responsibility for making decisions on unsuitability petitions to the Director of OSM (30 CFR 769.4(a) and 30 CFR 769.18(a)). However, in cases where the Director's decision does not concur with the decision recommendation of the Federal surface-managing agency for a petition area, the Secretary intervenes to resolve the disagreement and to make a final decision on the subject unsuitability petition (30 CFR 769.18(c).) Because this document not only evaluates the Red Rim petition (by way of a PED) but constitutes an EIS, NEPA mandates that it address a "no-action alternative" (40 CFR 1502.14(d)), whereby the Secretary would make no findings with respect to the petition. However, because the Department of the Interior is required by Section 522 of SMCRA to issue a decision on the complete petition it has received, implementing the no-action alternative for the Red Rim petition would not be reasonable. Therefore, although the no-action alternative is included as alternative E in this PED/EIS, it is not analyzed further here.

The four reasonable decision alternatives analyzed in the PED/EIS are: (1) to designate the entire petition area as unsuitable for all surface coal mining operations (alternative A, grant the petition); (2) to not designate any of the petition area as unsuitable for surface coal mining operations (alternative B, deny the petition); (3) to designate parts of the petition area as unsuitable for surface coal mining operations (alternative C, grant the petition as it pertains to parts of the petition area); and (4) to designate the entire petition area as unsuitable for surface coal mining, but to allow underground mining (alternative D). (For the purposes of this document, "surface coal mining operations" means either those activities conducted in connection with a surface coal mine or the surface effects of an underground coal mine. See Section 701(28)(A) of SMCRA for the definition of "surface coal mining operations.")

In its mitigation requirements for the proposed Red Rim coal lease tract (appendix J), BLM has stipulated that the successful lessee of the tract not create

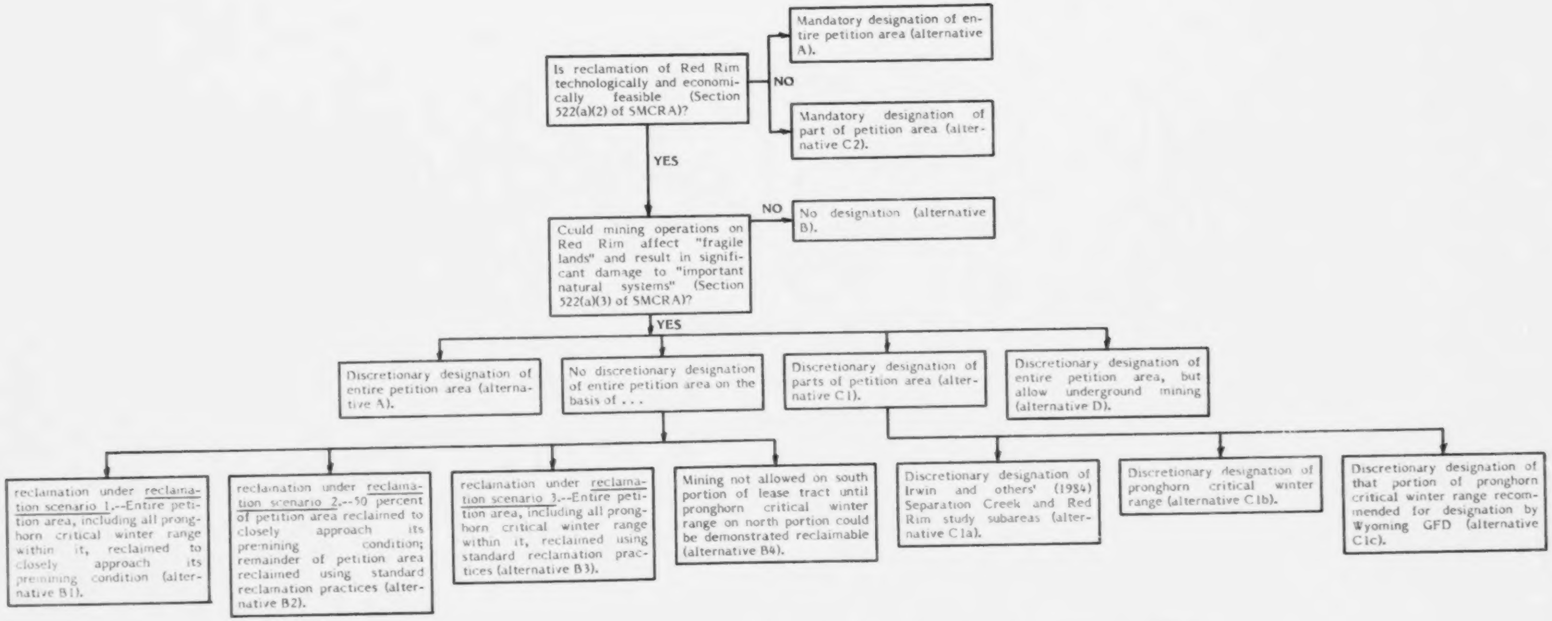

Is reclamation of Red Rim technologically and economically feasible (Section 522(a)(2) of SMCRA)?
NO
Mandatory designation of entire petition area (alternative A).
Mandatory designation of part of petition area (alternative C2).
YES
Could mining operations on Red Rim affect "fragile lands" and result in significant damage to "important natural systems" (Section 522(a)(3) of SMCRA)?
NO
No designation (alternative B).
YES
Discretionary designation of entire petition area (alternative A).
No discretionary designation of entire petition area on the basis of . . .
Discretionary designation of parts of petition area (alternative C1).
Discretionary designation of entire petition area, but allow underground mining (alternative D).
reclamation under reclamation scenario 1.--Entire petition area, including all pronghorn critical winter range within it, reclaimed to closely approach its premining condition (alternative B1).
reclamation under reclamation scenario 2.--50 percent of petition area reclaimed to closely approach its premining condition; remainder of petition area reclaimed using standard reclamation practices (alternative B2).
reclamation under reclamation scenario 3.--Entire petition area, including all pronghorn critical winter range within it, reclaimed using standard reclamation practices (alternative B3).
Mining not allowed on south portion of lease tract until pronghorn critical winter range on north portion could be demonstrated reclaimable (alternative B4).
Discretionary designation of Irwin and others' (1984) Separation Creek and Red Rim study subareas (alternative C1a).
Discretionary designation of pronghorn critical winter range (alternative C1b).
Discretionary designation of that portion of pronghorn critical winter range recommended for designation by Wyoming GFD (alternative C1c).

Figure I-3.--Possible decisions on the Red Rim unsuitability petition.

any surface disturbance (except for telephone lines or powerlines, if approved by BLM) within the Separation Creek riparian zone, the golden eagle nest buffer zones, and the pronghorn no surface occupancy areas. Therefore, these areas, identified by BLM during its land-use planning process for the Red Rim tract, would not be mined under any alternative that would otherwise allow surface coal mining operations on all or a part of the petition area (alternatives B, C, and D). (For a discussion of BLM's land-use planning process for the Red Rim tract, see section E of this chapter.) OSM assumes that the boundaries of these no surface occupancy areas would not change prior to BLM leasing the tract. The descriptions of alternatives A through C that follow (and of subalternatives to them, except alternative C2) are accompanied each by a map (or maps) showing the areas, if any, that would be designated unsuitable for surface coal mining operations should the alternative being described be implemented. The description of alternative C2 is not accompanied by a map, because OSM identified no part of the petition area where reclamation would not be technologically and economically feasible. The description of alternative D is not accompanied by a map, because OSM considered no specific underground mining alternative in this document. BLM's no surface occupancy areas, which would remain undisturbed by surface coal mining operations under all alternatives, are shown on each of these maps, together with other portions of the petition area that would be precluded from mining under the alternative. Please note that BLM has refined its legal description of the pronghorn no surface occupancy area since the publication of the draft PED/EIS. The pronghorn no surface occupancy area as currently described is generally, but not precisely, the same area as the October 6, 1981, and the May 21, 1982, pronghorn no surface occupancy areas addressed in the draft PED/EIS.

1. Alternative A: Designate the Entire Petition Area as Unsuitable for All Surface Coal Mining Operations

Under this alternative, the Secretary of the Interior would find either (1) that the mandatory criterion of Section 522(a)(2) of SMCRA has been met (that is, that mining and reclamation would not be technologically and economically feasible) or (2) that, under the discretionary criterion of Section 522(a)(3) of SMCRA, the potential for significant damage to important natural systems in the petition area should preclude surface coal mining operations. These findings would be made on the basis of evaluations of the allegations of the petition, of information provided by OSM or other governmental agencies, of any other relevant information submitted during the comment period on this PED/EIS, and of the information provided by and the recommendation of BLM.

Implementation of this alternative would preclude any surface coal mining operations within the petition area (fig. I-4), any future Federal coal leasing for mining operations unless such designation were later terminated by petition, and the extraction of about 69.0 million short tons of recoverable coal in the petition area.

As a consequence of this designation, no impacts to other resources from coal mining activities would occur. Vegetation, soils, and critical wildlife habitat would remain essentially in their present condition, provided that land-use and pronghorn-management objectives are attained.

National coal consumption should not (within the foreseeable future) be limited by supply constraints caused by designating the petition area as unsuitable for mining. In 1980, the U.S. Department of Energy (DOE) reported that the coal

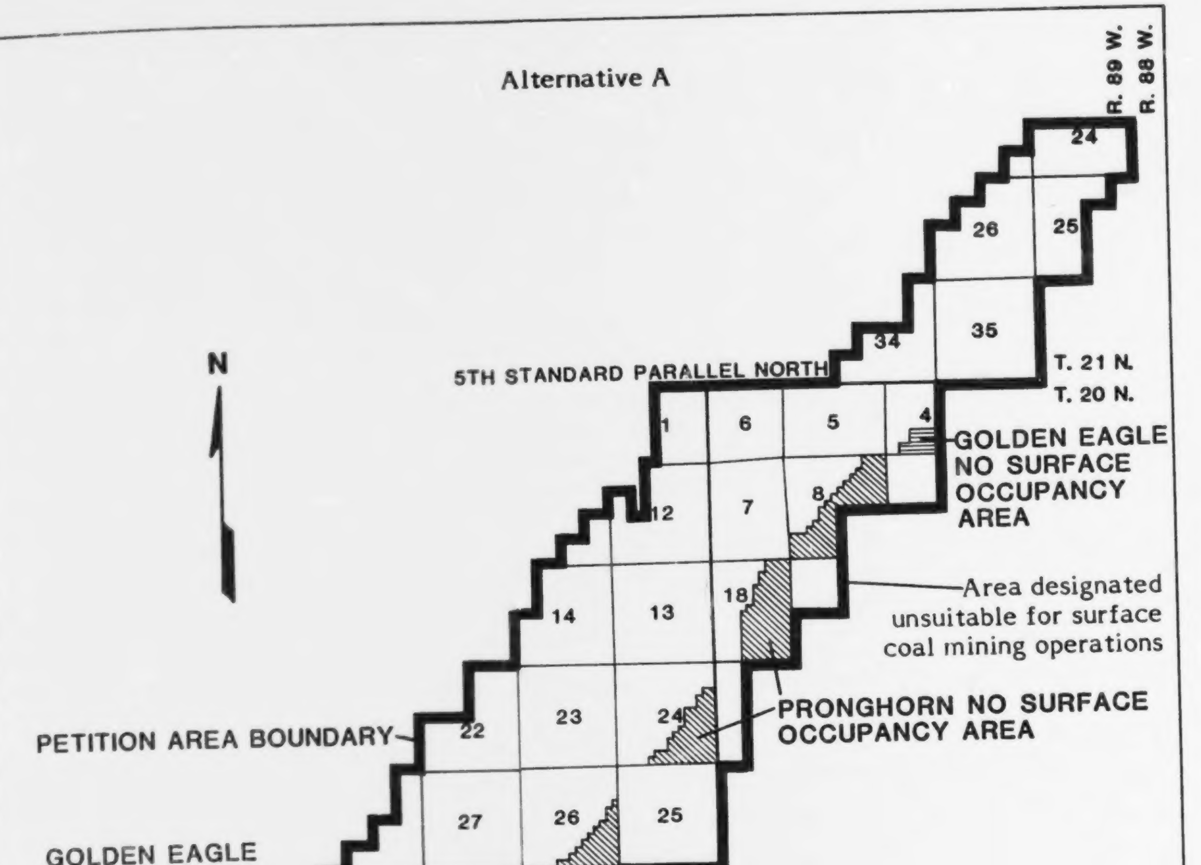

Alternative A
R. 89 W.
R. 88 W.
24
26
25
35
34
T. 21 N.
T. 20 N.
5TH STANDARD PARALLEL NORTH
N
1
6
5
4
GOLDEN EAGLE NO SURFACE OCCUPANCY AREA
12
7
8
Area designated unsuitable for surface coal mining operations
14
13
18
PRONGHORN NO SURFACE OCCUPANCY AREA
PETITION AREA BOUNDARY
22
23
24
27
26
25
GOLDEN EAGLE NO SURFACE OCCUPANCY AREA
33
34
35
R. 90 W.
R. 89 W.
T. 20 N.
T. 19 N.
6
5
4
AREAS NOT INCLUDED IN PETITION
8
7
RIPARIAN ZONE NO SURFACE OCCUPANCY AREA
18
17
24
19
25
30
R 91 W
R 90 W
0
1
2
4
SCALE IN MILES

Figure I-4.--Area designated as unsuitable for surface coal mining operations under alternative A. BLM's no surface occupancy areas would not be imposed under this alternative, because the entire petition area would be designated as unsuitable for surface coal mining operations.

industry was producing at only 87.9 percent of its existing capacity (U.S. Department of Energy, 1980). In 1984, Wyoming produced 128 million tons of coal (U.S. Department of Energy, 1985). Because the current coal market is soft, most active coal-producing mines in the State have a greater capacity to produce coal than is currently being tapped. The Office of Technology Assessment (OTA) reports that, as of 1981, 208 existing undeveloped coal leases, containing 4.1 billion tons of recoverable reserves, had favorable prospects for development by 1991. The majority of these reserves are located in the Wyoming portion of the Powder River Basin (3.2 billion tons) and in the Uinta region of Utah (0.4 billion tons; Office of Technology Assessment, 1981). Coal from these two regions would most likely supply the same market that coal from the petition area would supply. Production from existing and proposed mines in the Green River-Hams Fork region of northwest Colorado and of southcentral and southwest Wyoming, in which Red Rim is located, in combination with production from mines that would operate should BLM implement its preferred alternative to lease an additional 759.3 million tons of recoverable coal in the Green River-Hams Fork region in 1985, would equal approximately 83 million tons of coal per year by 1995 (Bureau of Land Management, 1983). Considering the projected coal production from the Powder River basin, the Unita region, and the Green River-Hams Fork region, a loss of production from Red Rim (2.5 million tons per year, 69 million tons over the life of the mine) owing to an unsuitability designation would not cause a significant impact to regional coal supplies. Therefore, petition-area coal is not essential to meet national demand. Moreover, a designation under alternative A may be terminated by petition (based on development of new data, technology, or reclamation techniques), thus precluding the possibility of petition-area coal being irreversibly lost.

2. Alternative B: Not Designate Any of the Petition Area as Unsuitable for Surface Coal Mining Operations

Under this alternative, the Secretary of the Interior would find insufficient cause to designate any of the petition area as unsuitable for surface coal mining operations. These decisions would not mean that the Secretary had, conversely, determined petition-area lands to be suitable for surface coal mining operations. The designation process as conceived by Congress is not intended to usurp the permitting and mining plan approval processes, which may also preclude or otherwise control such operations. For mining to take place at Red Rim, OSM (in accordance with SMCRA and NEPA) and Wyoming DEQ (in accordance with WEQA) would have to approve a permit application and issue a permit to mine coal to a permit applicant for the area. In addition, the Secretary of the Interior (in accordance with the Mineral Leasing Act of 1920, as amended) would have to approve a mining plan. (Obviously, prior to OSM, Wyoming DEQ, and the Secretary taking any of these actions, BLM would have to lease the proposed Red Rim coal lease tract and application would have to be made to mine it.) Any application for a permit and mining plan to mine Federal coal on Red Rim would be reviewed with assistance from BLM, the Federal surface- and coal-managing agency, and would consider previous environmental analyses of the area (see section E of this chapter for a discussion of the BLM coal leasing and land-use planning environmental analyses that have been performed for the Red Rim area), as well as comments and recommendations from other State and Federal agencies and the public.

The probable impacts of surface coal mining operations at Red Rim on the area are described in chapter IV of this document in terms of three reclamation scenarios, which OSM developed to encompass the full range of possible approaches to reclamation of the area. (See section IVA.) Should the Secretary of the Interior find that mining operations at Red Rim could affect fragile lands or result in significant damage to important natural systems, he could still, at his discretion, approve a mining plan and issue a permit to mine the area. So doing, he could require that the area be reclaimed in accordance with any one of these three reclamation scenarios or with any other reclamation plan deemed appropriate to mitigate the effects of surface coal mining operations on the Red Rim pronghorn critical winter range. The alternative to not designate any of the petition area as unsuitable for surface coal mining (alternative B) comprises three subalternatives that correspond to possible requirements to reclaim Red Rim under each of the three scenarios (fig. I-5), as well as a fourth subalternative whereby, before it would be allowed to mine the south portion of the Red Rim coal lease tract, the lessee of the tract would be required to demonstrate that pronghorn critical winter range in the north portion of the tract could be successfully reclaimed (fig. I-6):

a. Alternative B1: Not designate as unsuitable for surface coal mining operations the entire petition area on the basis that the area, including all pronghorn critical winter range within it, would be reclaimed to closely approach its premining condition

This alternative is analyzed as reclamation scenario 1 in chapter IV. Under it, the Secretary of the Interior would require that the entire petition area, including the pronghorn critical winter range, be reclaimed to closely approach its premining condition. (Note that BLM's no surface occupancy areas would remain undisturbed by surface coal mining operations under this alternative.)

b. Alternative B2: Not designate as unsuitable for surface coal mining operations the entire petition area on the basis that half the area would be reclaimed to closely approach its premining condition; the other half would be reclaimed using standard reclamation practices to a multiple-use native grassland for livestock grazing and wildlife habitat

This alternative is analyzed as reclamation scenario 2 in chapter IV. Under it, the Secretary of the Interior would require that about 50 percent of the petition area, including part of the pronghorn critical winter range, be reclaimed to closely approach its premining condition. The remainder of the petition area would be reclaimed using standard reclamation practices. OSM developed this subalternative because the Federal and private lands that are dispersed in a checkerboard pattern over the entire petition area could be reclaimed differently according to what the Secretary and Wyoming DEQ require for reclamation on Federal and private lands, respectively. (Note that BLM's no surface occupancy areas would remain undisturbed by surface coal mining operations under this alternative.)

c. Alternative B3: Not designate as unsuitable for surface coal mining operations the entire petition area on the basis that the area, including all pronghorn critical winter range within it, would be reclaimed using standard reclamation practices to a multiple-use native grassland for livestock grazing and wildlife habitat

This alternative is analyzed as reclamation scenario 3 in chapter IV. Under it, the Secretary of the Interior would require that the entire petition area be reclaimed using standard reclamation practices. (Note that BLM's no surface

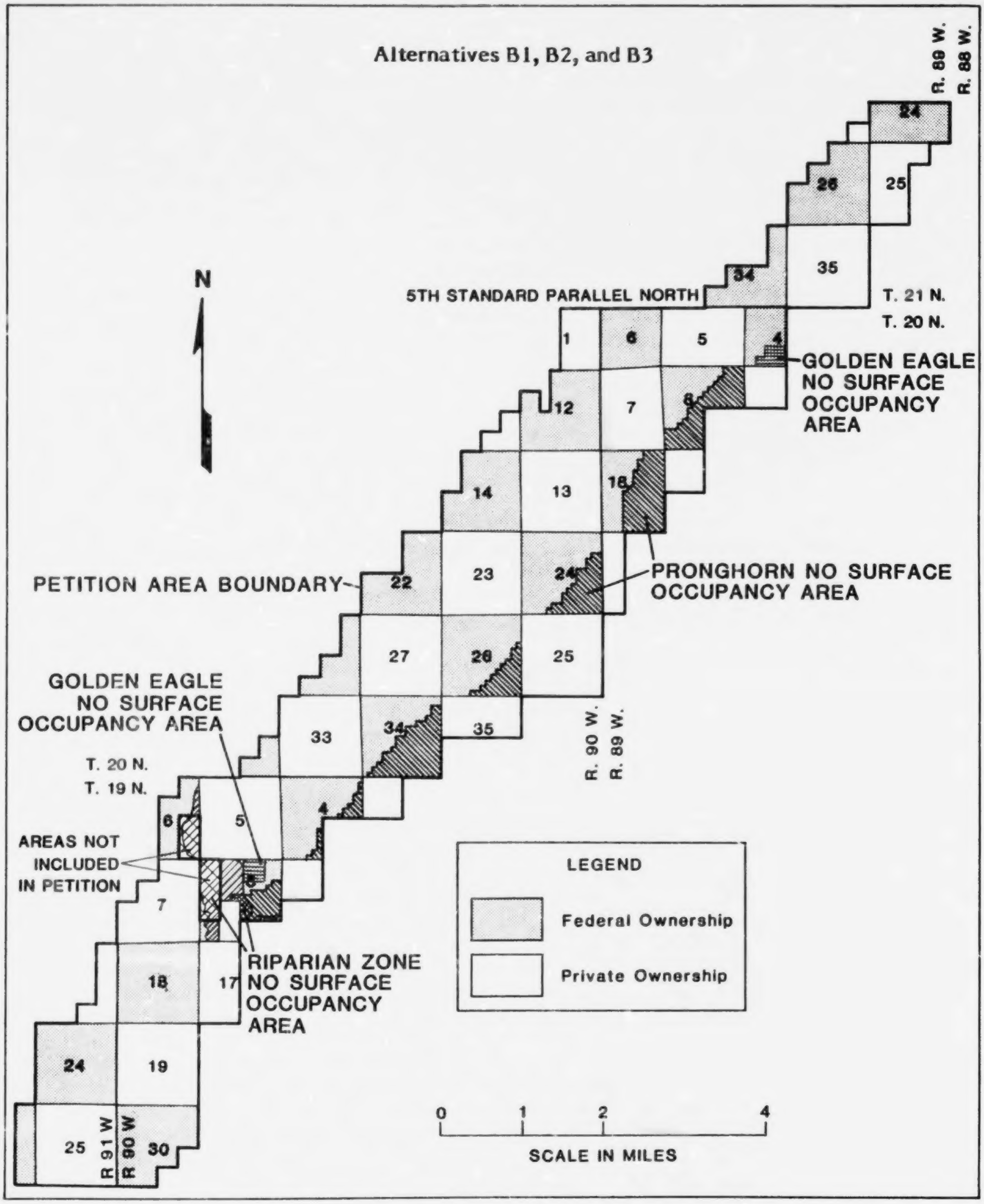

Alternatives B1, B2, and B3
R. 89 W.
R. 88 W.
N
5TH STANDARD PARALLEL NORTH
T. 21 N.
T. 20 N.
GOLDEN EAGLE NO SURFACE OCCUPANCY AREA
PRONGHORN NO SURFACE OCCUPANCY AREA
PETITION AREA BOUNDARY
GOLDEN EAGLE NO SURFACE OCCUPANCY AREA
T. 20 N.
T. 19 N.
AREAS NOT INCLUDED IN PETITION
RIPARIAN ZONE NO SURFACE OCCUPANCY AREA
R. 90 W.
R. 89 W.
R 91 W
R 90 W
24
26
25
34
35
1
6
5
4
12
7
8
14
13
18
22
23
24
27
26
25
33
34
35
6
5
4
8
7
18
17
24
19
25
30
LEGEND
Federal Ownership
Private Ownership
0
1
2
4
SCALE IN MILES

Figure I-5.--The areas within which no surface disturbances would be allowed under alternatives B1, B2, and B3. None of the petition area would be designated as unsuitable for surface coal mining operations, but BLM's no surface occupancy areas would remain undisturbed by surface coal mining operations. The checkerboard land-ownership pattern is shown to indicate that the Federal and private lands would be reclaimed differently under alternative B2.

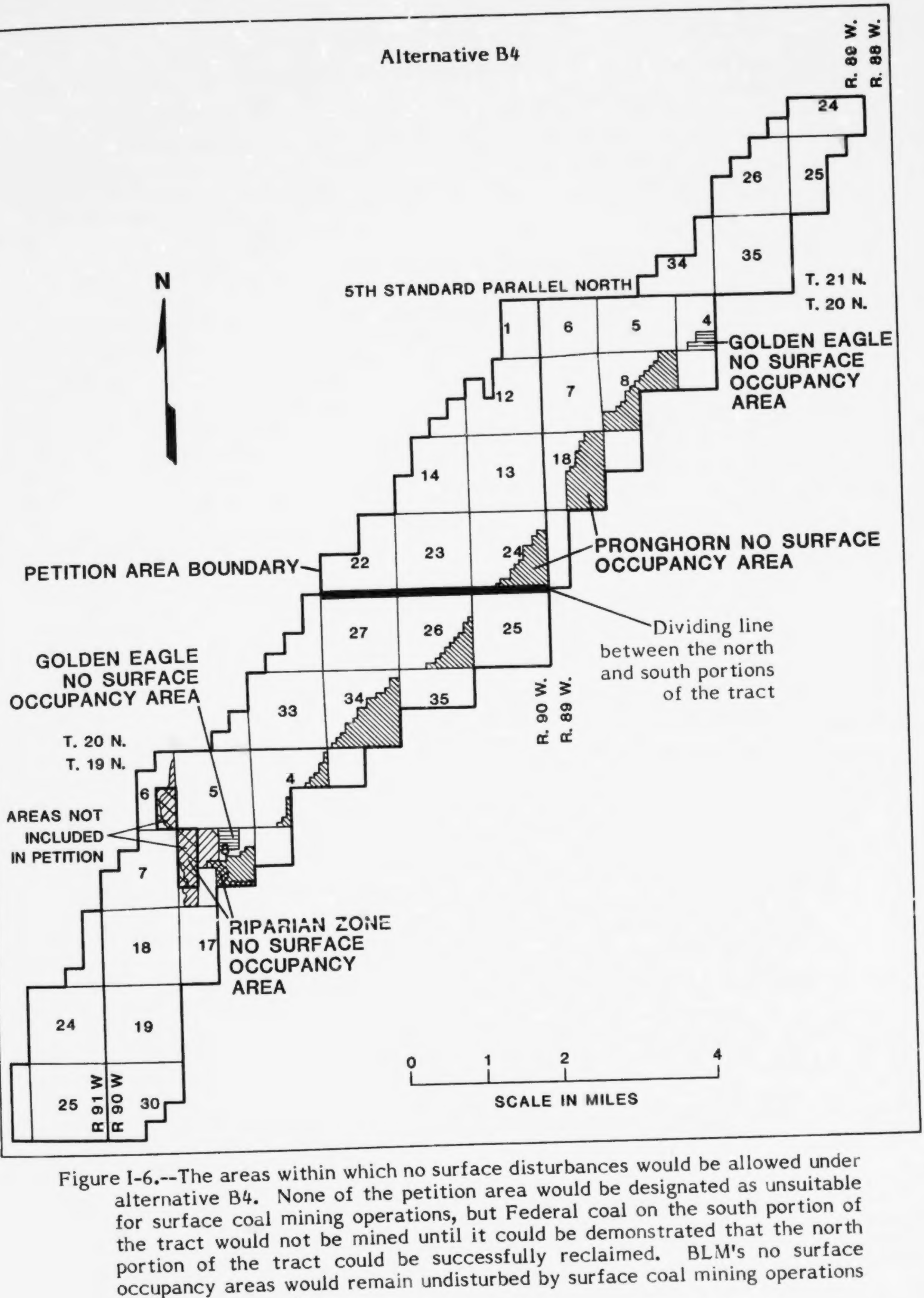

Alternative B4
R. 89 W.
R. 88 W.
N
5TH STANDARD PARALLEL NORTH
T. 21 N.
T. 20 N.
GOLDEN EAGLE NO SURFACE OCCUPANCY AREA
PRONGHORN NO SURFACE OCCUPANCY AREA
PETITION AREA BOUNDARY
Dividing line between the north and south portions of the tract
R. 90 W.
R. 89 W.
GOLDEN EAGLE NO SURFACE OCCUPANCY AREA
T. 20 N.
T. 19 N.
AREAS NOT INCLUDED IN PETITION
RIPARIAN ZONE NO SURFACE OCCUPANCY AREA
R 91 W
R 90 W
0
1
2
4
SCALE IN MILES
24
26
25
35
34
1
6
5
4
12
7
8
14
13
18
22
23
24
27
26
25
33
34
35
6
5
4
7
8
18
17
24
19
25
30

Figure I-6.--The areas within which no surface disturbances would be allowed under alternative B4. None of the petition area would be designated as unsuitable for surface coal mining operations, but Federal coal on the south portion of the tract would not be mined until it could be demonstrated that the north portion of the tract could be successfully reclaimed. BLM's no surface occupancy areas would remain undisturbed by surface coal mining operations under this alternative.

occupancy areas would remain undisturbed by surface coal mining operations under this alternative.)

d. Alternative B4: Not designate as unsuitable for surface coal mining operations the entire petition area but require the lessee to demonstrate the success of reclamation of the pronghorn critical winter range in the north portion of the Red Rim coal lease tract before allowing the south portion of the tract to be mined

Under this alternative, the Secretary of the Interior would divide the Red Rim coal lease tract (which is approximately equivalent to the petition area) into north and south portions (fig. I-6). The south portion of the tract would include most of Irwin and others' (1984) Separation Creek and Red Rim study subareas. (See alternative C1a.) These areas support about three-fourths of the wintering pronghorn population at Red Rim. He would stipulate that the north portion of the tract could be mined, subject to the approval of a mining plan and issuance of a permit, but that the south portion could not be mined until reclamation in compliance with SMCRA, Wyoming DEQ regulations, and BLM's pronghorn habitat recovery and replacement plan had been successfully implemented on the north portion. This stipulation by the Secretary would become either a condition of BLM's lease for the tract or an OSM permit requirement. (Note that BLM's no surface occupancy areas would remain undisturbed by surface coal mining operations under this alternative.)

3. Alternative C: Designate Parts of the Petition Area as Unsuitable for Surface Coal Mining Operations

Under this alternative, the Secretary of the Interior would find sufficient cause to designate only certain parts of the petition area as unsuitable for surface coal mining operations. The Secretary's finding of sufficient cause could be based on one of two possible criteria: (1) he may find that surface coal mining operations would affect or significantly damage certain areas comprising fragile lands or important natural systems (Section 522(a)(3)(B) of SMCRA; alternatives C1a, C1b, and C1c) or (2) he may find that these operations would affect certain areas that could not be technologically and economically reclaimed (Section 522(a)(2) of SMCRA; alternative C2). If the Secretary bases his finding on the first of these criteria, he may designate that portion of the petition area to which the finding pertains as unsuitable for surface coal mining operations. If he bases his finding on the second of these criteria, he shall designate the subject portion as unsuitable. Should the Secretary designate any portion of the petition area as unsuitable for surface coal mining operations, the remainder of the petition area may be reclaimed in accordance with any one of the three reclamation scenarios developed by OSM to encompass the full range of possible approaches to reclamation of the area or with any other reclamation plan deemed appropriate to mitigate the effects of surface coal mining operations on Red Rim. (See alternatives B1, B2, and B3.)

a. Alternative C1: Designate as unsuitable for all surface coal mining operations those parts of the petition area in which operations would result in significant damage to important natural systems

Under this alternative, the Secretary of the Interior would find that certain parts of the petition area are unsuitable for surface coal mining operations on the basis of the criteria of Section 522(a)(3)(B) of SMCRA. SMCRA provides that the

Secretary may designate an area unsuitable for all or certain types of surface coal mining operations if such operations would affect fragile lands or result in significant damage to important natural systems. OSM has identified three subalternatives subordinate to this alternative:

Alternative C1a: Designate as unsuitable for all surface coal mining operations Irwin and others' (1984) Separation Creek and Red Rim study subareas.--To determine where pronghorn concentrate at Red Rim, Irwin and others (1984) divided a 24,621-acre study area, which contains the entire 17,582-acre Red Rim pronghorn critical range designated by Wyoming Game and Fish Department (GFD; fig. II-1), into four different subareas (the Red Rim, the Separation Creek, the Central, and the North subareas). According to Irwin and others, the Separation Creek and the Red Rim subareas represent about 55 percent of the total study area but support about 76 percent of the wintering pronghorn population at Red Rim. About half of each of these two subareas falls within the Red Rim petition area (fig. I-7). Under this alternative, the Secretary would find that (1) that portion of the petition area coinciding with the Separation Creek and Red Rim study subareas comprises fragile lands or important natural systems and (2) this subject portion is unsuitable for surface coal mining operations. (Note that BLM's no surface occupancy areas, outside the Separation Creek and Red Rim study subareas, would also remain undisturbed by surface coal mining operations under this alternative.)

Alternative C1b: Designate as unsuitable for all surface coal mining operations the pronghorn critical winter range delineated by Wyoming GFD.--Under this alternative, the Secretary would find that (1) that portion of the petition area coinciding with the pronghorn critical winter range delineated by Wyoming GFD (fig. I-8) comprises fragile lands or important natural systems and (2) this subject portion is unsuitable for surface coal mining operations. (Note that BLM's no surface occupancy areas, outside the pronghorn critical winter range, would also remain undisturbed by surface coal mining operations under this alternative.)

Alternative C1c: Designate as unsuitable for all surface coal mining operations that portion of the pronghorn critical winter range recommended for designation by Wyoming GFD.--During the comment period on the petition and draft PED/EIS, Wyoming GFD submitted to Wyoming EQC a proposal it had developed, whereby the Secretary of the Interior and Wyoming EQC would designate only part of that portion of the pronghorn critical winter range delineated by Wyoming GFD and coinciding with the petition area as unsuitable for surface coal mining operations (fig. I-9). (Note that Wyoming GFD developed its proposal before Wyoming EQC had made its decision on the petition as it related to private lands. See Wyoming GFD's comments in the "Written Statements of Public-Hearing Testimony and Post-Hearing Comments" section of the second volume of this PED/EIS.) Wyoming GFD submitted its proposal in response to a request, made by Wyoming EQC at the public hearing, that that department develop a viable partial-designation alternative. Wyoming GFD's proposal is fivefold. First, Wyoming GFD proposes that that portion of the pronghorn critical winter range shown on figure I-9 be designated as unsuitable for surface coal mining operations. Second, it proposes that, for that portion of the pronghorn critical winter range not designated as unsuitable for surface coal mining operations but still within the petition area, a no surface occupancy stipulation be imposed to protect all sagebrush vegetation types within the subject portion except those that overlie a coal seam. (Coal beds in the petition area dip west-northwest from where they crop out, so that, in effect, all of the land surface within the critical winter range not to be designated as unsuitable for surface coal mining operations overlies a

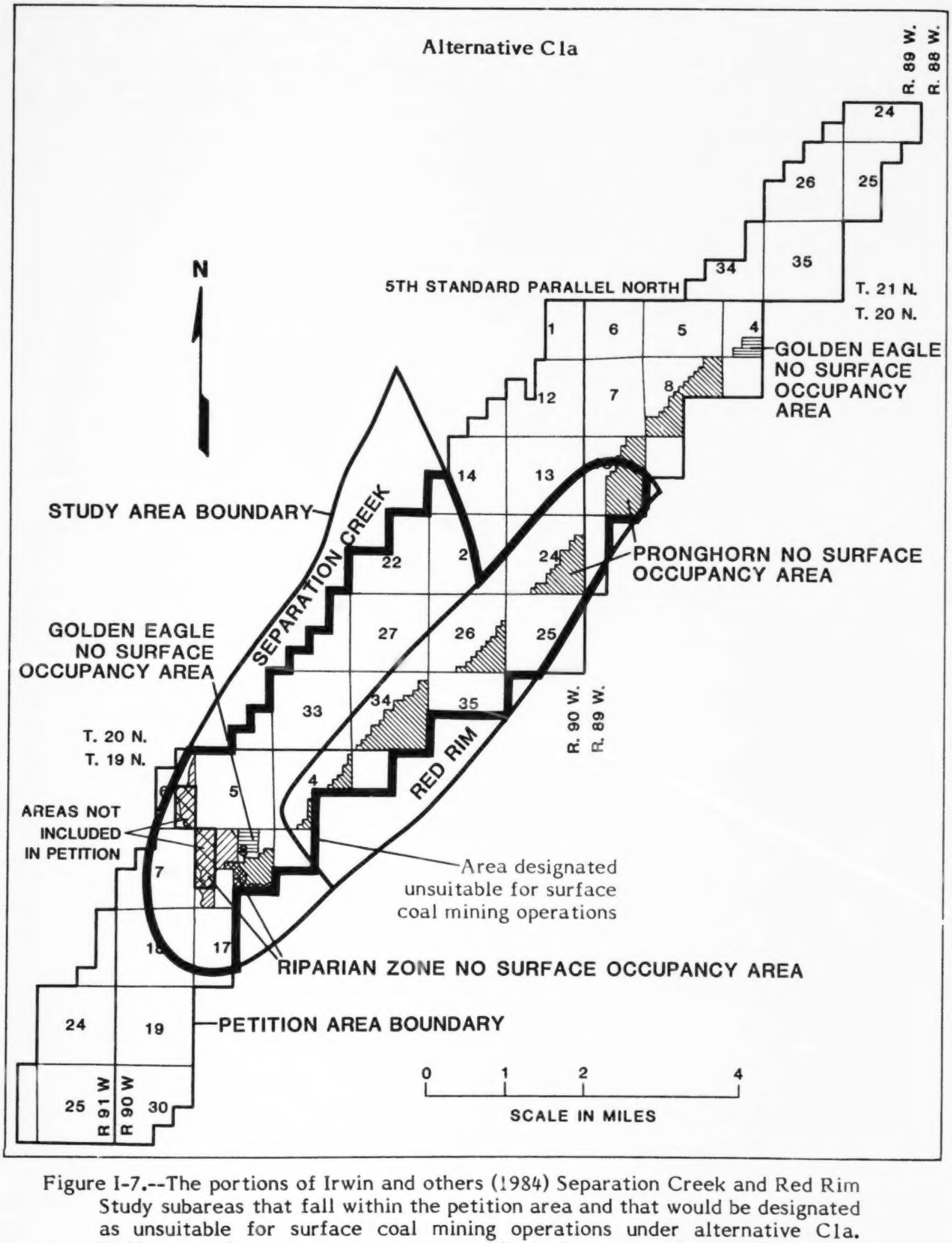

Alternative C1a
R. 89 W.
R. 88 W.
N
5TH STANDARD PARALLEL NORTH
T. 21 N.
T. 20 N.
GOLDEN EAGLE NO SURFACE OCCUPANCY AREA
STUDY AREA BOUNDARY
SEPARATION CREEK
PRONGHORN NO SURFACE OCCUPANCY AREA
GOLDEN EAGLE NO SURFACE OCCUPANCY AREA
R. 90 W.
R. 89 W.
T. 20 N.
T. 19 N.
RED RIM
AREAS NOT INCLUDED IN PETITION
Area designated unsuitable for surface coal mining operations
RIPARIAN ZONE NO SURFACE OCCUPANCY AREA
PETITION AREA BOUNDARY
R 91 W
R 90 W
0
1
2
4
SCALE IN MILES
24
26
25
35
34
1
6
5
4
12
7
8
14
13
22
2
24
27
26
25
33
34
35
4
5
6
7
8
18
17
24
19
25
30

Figure I-7.--The portions of Irwin and others (1984) Separation Creek and Red Rim Study subareas that fall within the petition area and that would be designated as unsuitable for surface coal mining operations under alternative C1a. BLM's no surface occupancy areas, outside the Separation Creek and Red Rim study subareas, would also remain undisturbed by surface coal mining operations under this alternative.

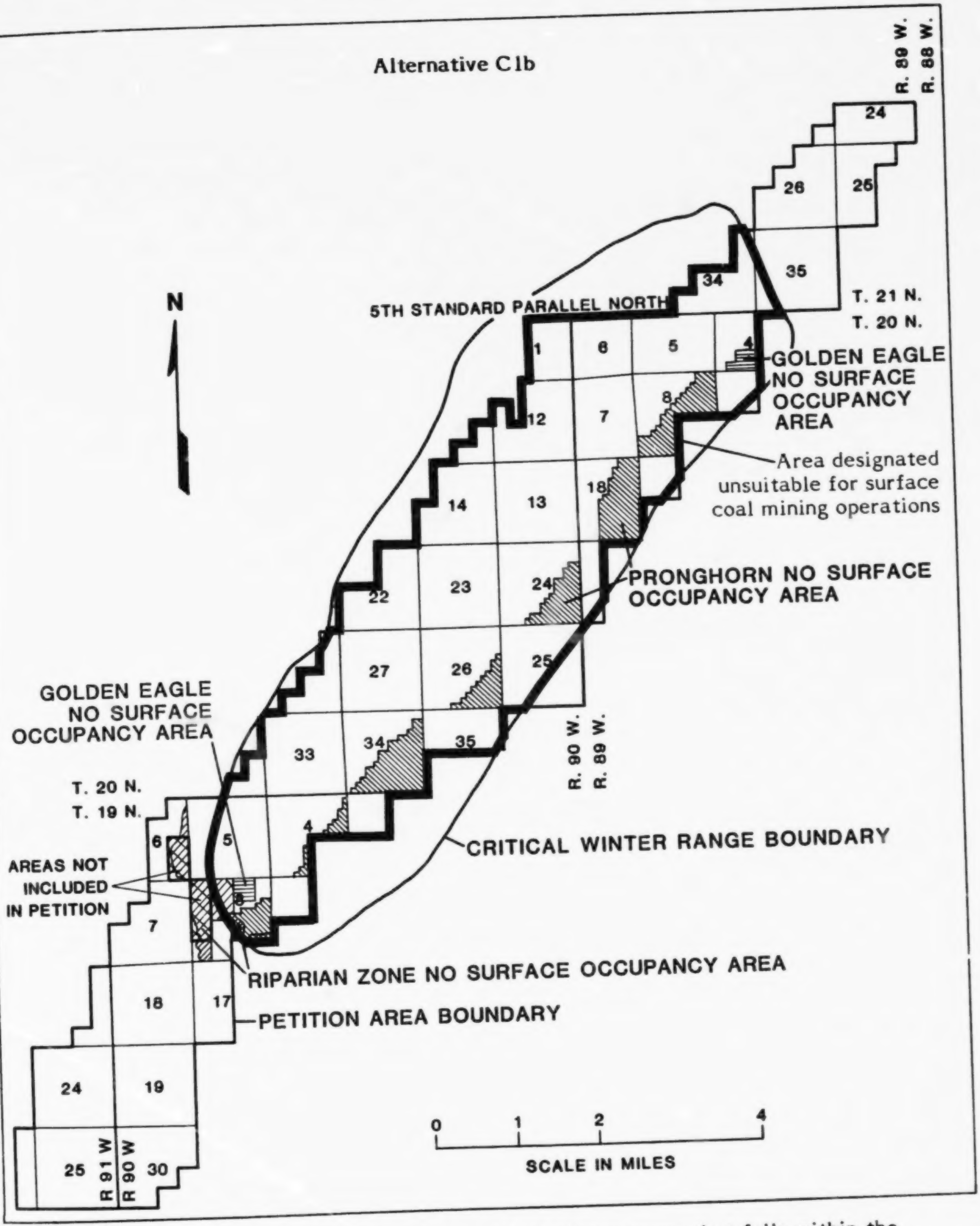
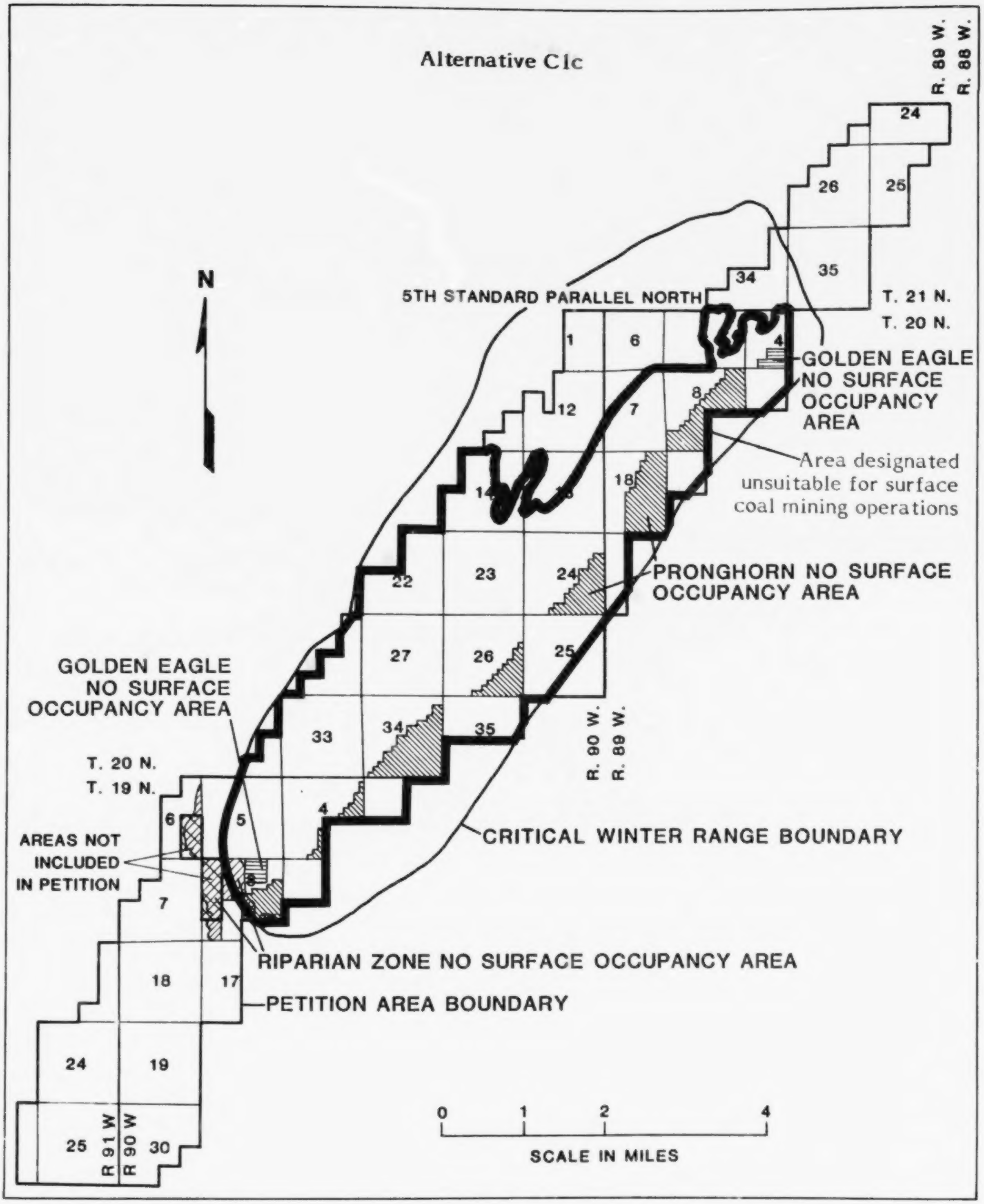

Alternative C1b
R. 89 W.
R. 88 W.
24
26
26
35
N
34
5TH STANDARD PARALLEL NORTH
T. 21 N.
T. 20 N.
1
6
5
4
GOLDEN EAGLE NO SURFACE OCCUPANCY AREA
12
7
8
Area designated unsuitable for surface coal mining operations
14
13
18
22
23
24
PRONGHORN NO SURFACE OCCUPANCY AREA
27
26
25
GOLDEN EAGLE NO SURFACE OCCUPANCY AREA
33
34
35
R. 90 W.
R. 89 W.
T. 20 N.
T. 19 N.
4
6
5
8
AREAS NOT INCLUDED IN PETITION
CRITICAL WINTER RANGE BOUNDARY
7
RIPARIAN ZONE NO SURFACE OCCUPANCY AREA
18
17
PETITION AREA BOUNDARY
24
19
0
1
2
4
SCALE IN MILES
25
R 91 W
R 90 W
30

Figure I-8.--The portion of the pronghorn critical winter range that falls within the petition area and that would be designated as unsuitable for surface coal mining operations under alternative C1b. BLM's no surface occupancy areas, outside the pronghorn critical winter range, would also remain undisturbed by surface coal mining operations under this alternative.


Alternative C1c
R. 89 W.
R. 88 W.
N
5TH STANDARD PARALLEL NORTH
T. 21 N.
T. 20 N.
GOLDEN EAGLE NO SURFACE OCCUPANCY AREA
Area designated unsuitable for surface coal mining operations
PRONGHORN NO SURFACE OCCUPANCY AREA
GOLDEN EAGLE NO SURFACE OCCUPANCY AREA
R. 90 W.
R. 89 W.
T. 20 N.
T. 19 N.
AREAS NOT INCLUDED IN PETITION
CRITICAL WINTER RANGE BOUNDARY
RIPARIAN ZONE NO SURFACE OCCUPANCY AREA
PETITION AREA BOUNDARY
R 91 W
R 90 W
0
1
2
4
SCALE IN MILES
24
26
25
34
35
1
6
4
12
7
8
14
13
18
22
23
24
27
26
25
33
34
35
6
5
4
8
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17
24
19
25
30

Figure I-9.--The portion of the pronghorn critical winter range recommended for designation by Wyoming GFD that would be designated as unsuitable for surface coal mining operations under alternative C1c. BLM's no surface occupancy areas, outside this part of the pronghorn critical winter range recommended for designation by Wyoming GFD, would also remain undisturbed by surface coal mining operations under this alternative.

coal seam. Therefore, OSM assumes that Wyoming GFD means sagebrush vegetation types could be disturbed only in mine-pit areas.) Third, Wyoming GFD proposes that the pronghorn no surface occupancy area identified by BLM be maintained and that the mitigation measures suggested in Governor Herschler's letter to BLM, dated July 27, 1981, be adopted. (See the letter from the Office of the Governor to Wyoming EQC in the "Written Comments" section of the second volume of this PED/EIS.) Fourth, it proposes that sagebrush forage lost as the result of mining-related disturbance within the Red Rim critical winter range be compensated for by changing the management policy for grazing in the Muddy Creek critical winter range (approximately 12 to 25 miles southwest of the Red Rim critical winter range) in order to increase that range's forage yield for the Baggs Herd until mined portions of Red Rim are reclaimed. Finally, Wyoming GFD proposes that reclamation restore premining shrub densities within disturbed sagebrush vegetation areas.

Under this alternative, the Secretary would find that (1) that portion of the pronghorn critical winter range recommended for designation by Wyoming GFD comprises fragile lands or important natural systems and (2) this subject portion is unsuitable for surface coal mining operations. (Note that BLM's no surface occupancy areas, outside of this part of the critical winter range recommended for designation by Wyoming GFD, would also remain undisturbed by surface coal mining operations under this alternative.)

b. Alternative C2: Designate as unsuitable for all surface coal mining operations those parts of the petition area on which reclamation is not technologically and economically feasible

Under this alternative, the Secretary of the Interior would find that certain parts of the petition area are unsuitable for surface coal mining operations on the basis of the criteria set forth in Section 522(a)(2) of SMCRA. SMCRA requires that an area be designated unsuitable for all or certain types of surface coal mining operations if the Secretary finds that reclamation of the area as required by SMCRA is not technologically and economically feasible.

Regarding the technological feasibility of reclamation, OSM has identified no part of the petition area that could not be reclaimed using standard reclamation practices (proposed under reclamation scenario 3). (For the purposes of this document, "standard reclamation practices" means those reclamation techniques that both minimally comply with requirements of the Wyoming State program and are currently being used in the State to reclaim areas disturbed by surface coal mining operations. The requirements of the Wyoming State program govern reclamation in the State, because this program is approved by the Secretary of the Interior to regulate surface coal mining operations in Wyoming under Section 503 of SMCRA. Wyoming holds a cooperative agreement with the Secretary to regulate such operations on Federal lands under Section 523 of SMCRA.) Reclamation of the petition area to a multiple-use native grassland for livestock grazing and wildlife habitat would be difficult, owing to severe climatic and environmental conditions in the area (e.g., low precipitation, dessicating winds, and a southwest exposure would hinder revegetation), but achievable.

The petitioners allege that the topography of the mined area must be precisely restored ("microcontoured") and that very high densities of shrubs must be promptly reestablished on the area (approximately proposed under reclamation scenario 1). To reclaim the petition area to closely approach its premining condition would be very difficult. Although the probability for failure of this type of reclamation would be much higher than the probability for failure of reclamation using standard reclamation practices, analyses performed by OSM do not conclusively show that this type of reclamation is technologically infeasible.

Regarding the economic feasibility of reclamation, OSM found that reclamation under reclamation scenarios 1, 2, and 3 would, on the average, cost approximately $41,000, $32,000, and $22,000 per acre, or $6.58, $5.04, and $3.49 per ton of coal produced (assuming a total of 69.0 million tons of coal were produced and 11,000 acres were disturbed), to perform. These reclamation costs are comparable with costs to reclaim other surface coal mines in Wyoming. Therefore, the cost of reclaiming Red Rim would not be prohibitively high; reclamation of the area would not be economically infeasible.

4. Alternative D: Designate the Entire Petition Area as Unsuitable for Surface Coal Mining, but Allow Underground Mining

Under this alternative, the Secretary of the Interior would find that the petition area is unsuitable for surface coal mining but suitable for underground mining. BLM has determined that the proposed Red Rim coal lease tract has moderate potential for subsurface mining (Bureau of Land Management, 1982). However, underground mining does not appear likely in the foreseeable future, because (1) the expense of mining the subbituminous coal resources at Red Rim would not be sufficiently offset by profits from that venture (only 50 to 55 percent of the in-place coal resource could be mined; U.S. Geological Survey, 1978); (2) significant health and safety problems could result from mining these particular steeply dipping multiple seams of coal; and (3) underground mining these coal seams could cause extensive surface subsidence, which could be environmentally unacceptable to OSM and BLM. Therefore, no specific underground mining alternative was considered in this document.

5. Alternative E: No Action

Under this alternative, the Secretary of the Interior would make no findings with respect to the Red Rim unsuitability petition; he would make no decision to designate or not designate all or any part of the petition area as unsuitable for all or certain types of surface coal mining operations.

Because this document not only evaluates the Red Rim petition (by way of a PED) but constitutes an EIS, NEPA mandates that it address a "no-action alternative." OSM evaluated the no-action alternative and determined it was not reasonable, because the petitioners fulfilled the requirements of Federal regulations and filed a complete petition to designate the subject lands as unsuitable for surface coal mining operations. Therefore, a decision by the Secretary of the Interior regarding the petition is required by law. However, because the impacts to the human environment of implementing the no-action alternative would be the same as those of not designating any of the petition area as unsuitable for surface coal mining operations (alternative B), for the purpose of the PED/EIS these alternatives are considered equivalent. For these reasons, the no-action alternative is not analyzed further. (Note that a decision to not designate all or any part of a petition area as unsuitable for all or certain types of surface coal mining operations would not mean that such lands have been, conversely, determined as suitable for such operations. That is, implementing either alternative B or the no-action alternative would not mean that surface coal mining operations within the petition area would necessarily occur. Mining would occur only if the coal were leased and if all appropriate mining permits and authorizations were obtained from State, local, and Federal agencies.)

E. BUREAU OF LAND MANAGEMENT LAND-USE PLANNING DECISIONS ON THE RED RIM AREA

The Federal Land Policy and Management Act of 1976 (FLPMA), P.L. 94-579, 90 Stat. 2743, 43 U.S.C. 1701 et seq., the Federal Coal Leasing Amendments Act of 1976 (30 U.S.C., Section 201(a)(3)(A)(i)), and Section 522(b) of SMCRA direct BLM to undertake comprehensive land-use planning, or land-use analyses, prior to leasing Federal lands in a given area for Federal coal development, to determine whether or not these lands are unsuitable for surface coal mining operations. In 1977, BLM made certain land-use decisions, under which the coal program for the Red Rim area is currently managed, as part of its 1977 Management Framework Plan (MFP) for the Overland Planning Unit. In 1979, it completed a coal-planning supplement to the Overland MFP. This supplement addresses the Red Rim/China Butte area specifically; it supplements the previous land-use decisions regarding Federal coal development in this area. On October 6, 1981, based upon these planning decisions, the Red Rim site-specific environmental analysis (Bureau of Land Management, 1981b), the Green River-Hams Fork regional coal EIS (Bureau of Land Management, 1980), and additional studies, BLM's Wyoming State Director determined the Red Rim tract to be acceptable for further consideration for coal leasing. (Note that the State Director's decision provided for the exclusion of certain portions of the tract from surface coal mining operations. These "no surface occupancy areas" for pronghorn critical winter range, golden eagle nest buffer zones, and the Separation Creek riparian zone are discussed at length in chapter III.) Based on these same land-use decisions, analyses, and studies, BLM identified mitigation requirements that would become either stipulations appended to a Federal coal lease for the Red Rim tract or requirements of a mine plan developed for this tract (appendix J; for clarification, see item No. 2, second BLM recommendation letter, appendix I).

In 1982, BLM prepared land-use planning decisions regarding the Divide Basin and Overland Planning Units (Bureau of Land Management, 1982). These units are bounded by the Colorado State line on the south, the northern edge of the Union Pacific land grant on the north, the North Platte River on the east, and the Rawlins BLM district boundary on the west; they include the Red Rim tract. BLM's 1982 planning decisions affirmed previous decisions and mitigation requirements for the Red Rim tract and also provided that, should the Red Rim tract be mined, approximately 63,300 acres of critical winter range south of Muddy Creek (fig. II-2), used by the Baggs Herd, be protected until that tract had been adequately reclaimed.

Specifically, BLM's 1982 decision was that no coal development should occur on mule-deer and pronghorn critical winter ranges within the Overland Planning Unit, except on China Butte, which contains mule-deer critical winter range, and Red Rim, which contains pronghorn critical winter range, until it has been shown that: (1) a critical winter range can be surface mined in a manner that would not significantly disrupt winter survival of the animals dependent on it and (2) sufficient critical winter range at China Butte and Red Rim has been reclaimed to mitigate or eliminate the impacts to mule deer and/or pronghorn from mining to the south of these areas (Bureau of Land Management, 1982). This was a consideration in BLM's decision that coal development of tracts in the Overland Planning Unit should commence with those located on the north end of the unit (including Red Rim and China Butte) and proceed sequentially southward. BLM reasoned that developing the southern portion of the unit first could (1) conflict with the capabilities of the communities there to accommodate the attendant growth, while directing population away from those communities in the north (including Rawlins) that need development, (2) cause mining companies to build extensive and expensive coal-transportation systems (probably railroad lines north to the main Union Pacific Railroad line), and (3) cause significant impacts to deer, pronghorn, and elk critical winter ranges to the north of the Wyoming-Colorado border (Bureau of Land Management, 1982).

Although BLM decided by way of its land-use planning process that Red Rim is acceptable for development, the Secretary of the Interior has not yet made a decision to lease the Red Rim tract.

Shortly after receiving the Red Rim petition, OSM, in accordance with 30 CFR 769.14(g), requested a recommendation from BLM on the petition. BLM's recommendation (appendix I) to reject the petition was based upon decisions it had reached during this same land-use planning process.

CHAPTER II

THE AFFECTED ENVIRONMENT

A. WILDLIFE

The Red Rim petition area supports a variety of birds, mammals, and herpetofauna. General descriptions of these wildlife are given in BLM's south-central Wyoming coal EIS and Green River-Hams Fork regional coal EIS (Bureau of Land Management, 1978, 1980).

Both vegetation and topography contribute to the suitability of the Red Rim petition area as habitat for wildlife. The major vegetation communities on the site include the big sagebrush, the greasewood, the saltbush, the mountain shrub, and the sandwort/goldenweed; these exist in a complex mosaic of shapes and sizes distributed throughout the Red Rim area. (See section IIC for a more detailed discussion of plant diversity.) The topography of the Red Rim petition area is diverse and strongly influences the vegetation of the area. Rock outcrops in the area are useful as shelter for certain species; steep, cliff-like areas serve as habitat for raptors; ponds and creeks sustain species requiring aquatic habitat. (See section IIB for a more detailed discussion of topographic diversity.)

Owing to their status as managed or protected species, sage grouse, raptors, mule deer, and pronghorn are of particular concern in the Red Rim area (Bureau of Land Management, 1981a, 1981b).

The principal value of the Red Rim area to sage grouse is as winter habitat, although sage grouse also nest and rear their broods there. High concentrations of sage grouse have been observed in portions of the petition area during winter, including a flock of more than 1,000 birds along Separation Creek (Bureau of Land Management, 1981a). Wyoming GFD estimates that up to 3,000 birds have been observed in the area (Wyoming Game and Fish Department, 1983).

Approximately 50 to 150 mule deer use the Red Rim area year round. Critical winter range for mule deer is located in parts of T. 20 N., R 89 W., secs. 4, 5, 6, 7, 8, 9, and 18, and T. 20 N., R. 90 W., secs. 12 and 13, in the northern portion of the petition area and the Red Rim pronghorn critical winter range (Bureau of Land Management, 1981a). This mule deer critical winter range totals approximately 2,900 acres.

The petition area serves as nesting and foraging habitat for several raptors, particularly golden eagles, prairie falcons, great-horned owls, and red-tailed and ferruginous hawks (Bureau of Land Management, 1981b). Golden eagles are protected by the Bald Eagle Protection Act. The prairie falcon and the ferruginous hawk are species of high Federal interest. BLM reported the presence of 11 golden eagle nests, 23 ferruginous hawk nests, and 8 prairie falcon nests on or immediately adjacent to the proposed coal lease tract. These numbers include both inactive and active nests.

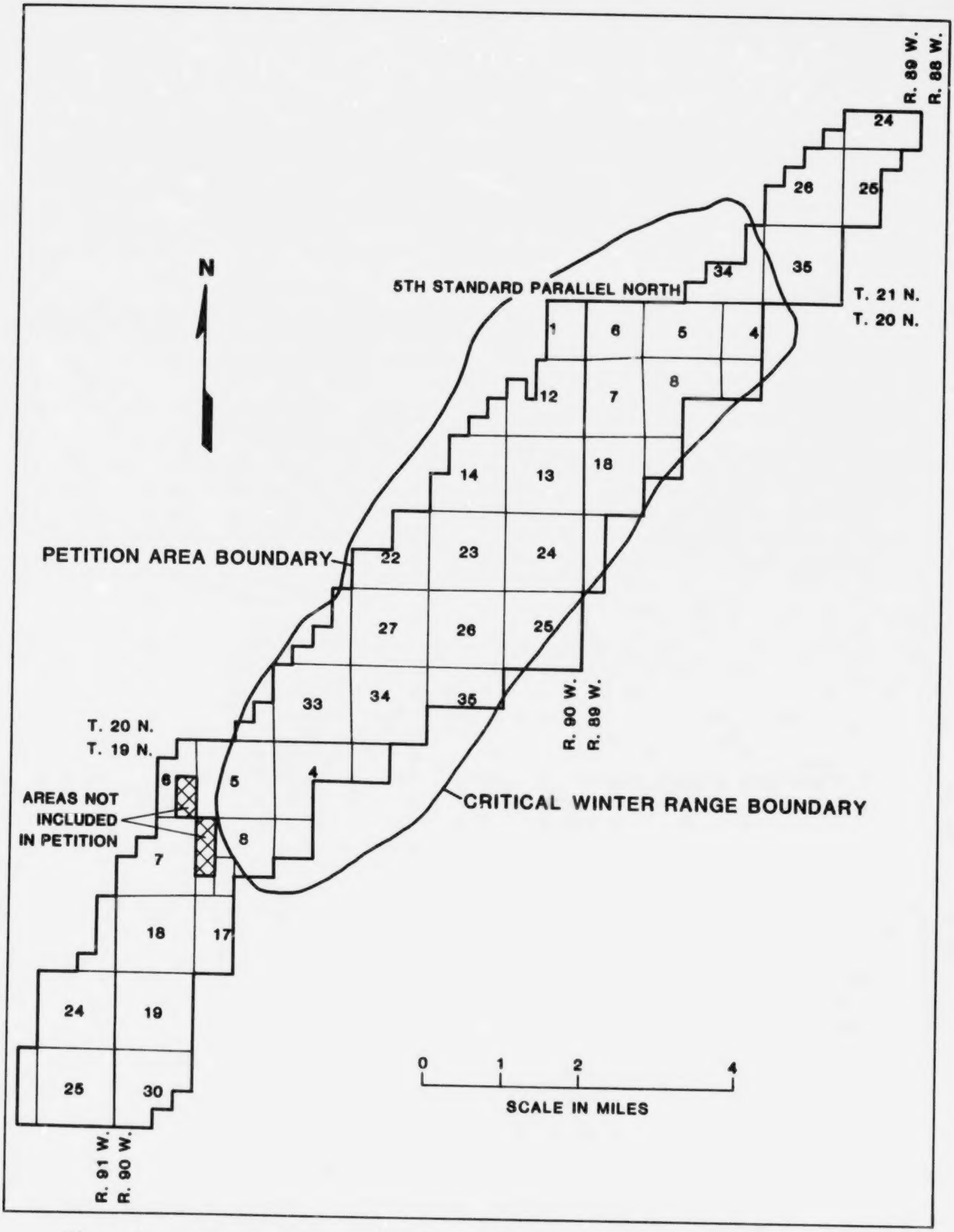
Pursuant to Section 7 of the Endangered Species Act, OSM consulted with the U.S. Fish and Wildlife Service (USFWS) and verified that the bald eagle, peregrine falcon, and black-footed ferret are potential inhabitants of the petition area.

Approximately two-thirds of the Red Rim petition area has been designated by Wyoming GFD as critical winter range for pronghorn (Antilocapra americana; fig. II-1). Wyoming GFD defines critical winter range as "that range that is present in minimum amounts and is the determining factor in the potential for population maintenance and/or growth. This will usually be represented by a winter concentration where most members of a population are forced during periods of maximum snow cover each year or where most members of a population are concentrated during periodic severe winters. The critical range may also be represented by late fall water source or other resources in short supply, e.g., cover for breeding, nesting, fawning, etc. The degree of criticalness is related to a specific herd and is not related to the density of animals relative to any other herd" (Walt Gasson, Wyoming Game and Fish Department, written communication, 1983). The first of the two principal allegations of the Red Rim petition is that this critical winter range constitutes valuable habitat for pronghorn that should not be mined. Therefore, the remainder of this wildlife discussion addresses pronghorn and their critical winter range in the Red Rim petition area.

The Red Rim critical winter range, which comprises approximately 17,582 acres (based on Bureau of Land Management, written communication, February 7, 1983; see appendix I), is one of two critical winter ranges designated by Wyoming GFD for the Baggs Herd (fig. II-2). Almost three-fourths of the Red Rim critical winter range lies within the petition area (fig. II-1). The second critical winter range for the Baggs Herd, which comprises approximately 63,300 acres, is situated south of Muddy Creek and east of State Highway 789, 12 to 25 miles southwest of the Red Rim critical winter range. In 1981, Wyoming GFD stated that browse species on the Muddy Creek critical winter range were being consumed not only be pronghorn, but by livestock and other wildlife species, at a high rate; it further stated that the Muddy Creek critical winter range would deteriorate from its current (1981) quality should additional pronghorn be displaced onto it by mining within the Red Rim critical winter range (Wyoming Game and Fish Department, 1981a). Wyoming GFD's statement was based on browse data collected by it and BLM during 1979 and 1980 from browse-utilization transects located on the Muddy Creek critical winter range. After Wyoming GFD issued its statement, the population of the Baggs Herd declined drastically (during the winter of 1983-84). Clearly, then, the number of pronghorn using these two critical winter ranges can vary dramatically. However, assuming that pronghorn, livestock, and other wildlife species' use of the Muddy Creek critical winter range is high at such time as Red Rim may be mined, pronghorn displaced from Red Rim by mining could contribute to overbrowsing of the Muddy Creek critical winter range.

According to Wyoming GFD, a deep snow belt, which forms most winters between the Red Rim and Muddy Creek critical winter ranges, hinders or prevents pronghorn in the Red Rim area from moving south to the Muddy Creek critical winter range (Wyoming Game and Fish Department, 1981a). Irwin and others (1984) confirm that Landsat photographs for the winters of 1972-73 and 1974-75 show Red Rim can remain relatively snow-free at the same time areas adjacent to it are covered by snow.

In 1981, Wyoming GFD prepared a briefing report for Governor Herschler analyzing the classification of Red Rim as pronghorn critical winter range (Wyoming Game and Fish Department, 1981a). This report states that the Red Rim and Muddy Creek critical winter ranges delineated by Wyoming GFD (fig. II-2) contain the necessary food and cover to support significant portions of the Baggs Herd during the winter. The critical winter range delineations are used by


N
5TH STANDARD PARALLEL NORTH
T. 21 N.
T. 20 N.
R. 89 W.
R. 88 W.
PETITION AREA BOUNDARY
CRITICAL WINTER RANGE BOUNDARY
AREAS NOT INCLUDED IN PETITION
T. 20 N.
T. 19 N.
R. 90 W.
R. 89 W.
R. 91 W.
R. 90 W.
24
26
25
34
35
1
6
5
4
12
7
8
14
13
18
22
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24
27
26
25
33
34
35
6
5
4
8
7
18
17
24
19
25
30
0
1
2
4
SCALE IN MILES

Figure II-1.--Location of the Red Rim pronghorn critical winter range designated by Wyoming GFD (based on Bureau of Land Management, written communication, February 7, 1983; see appendix I).

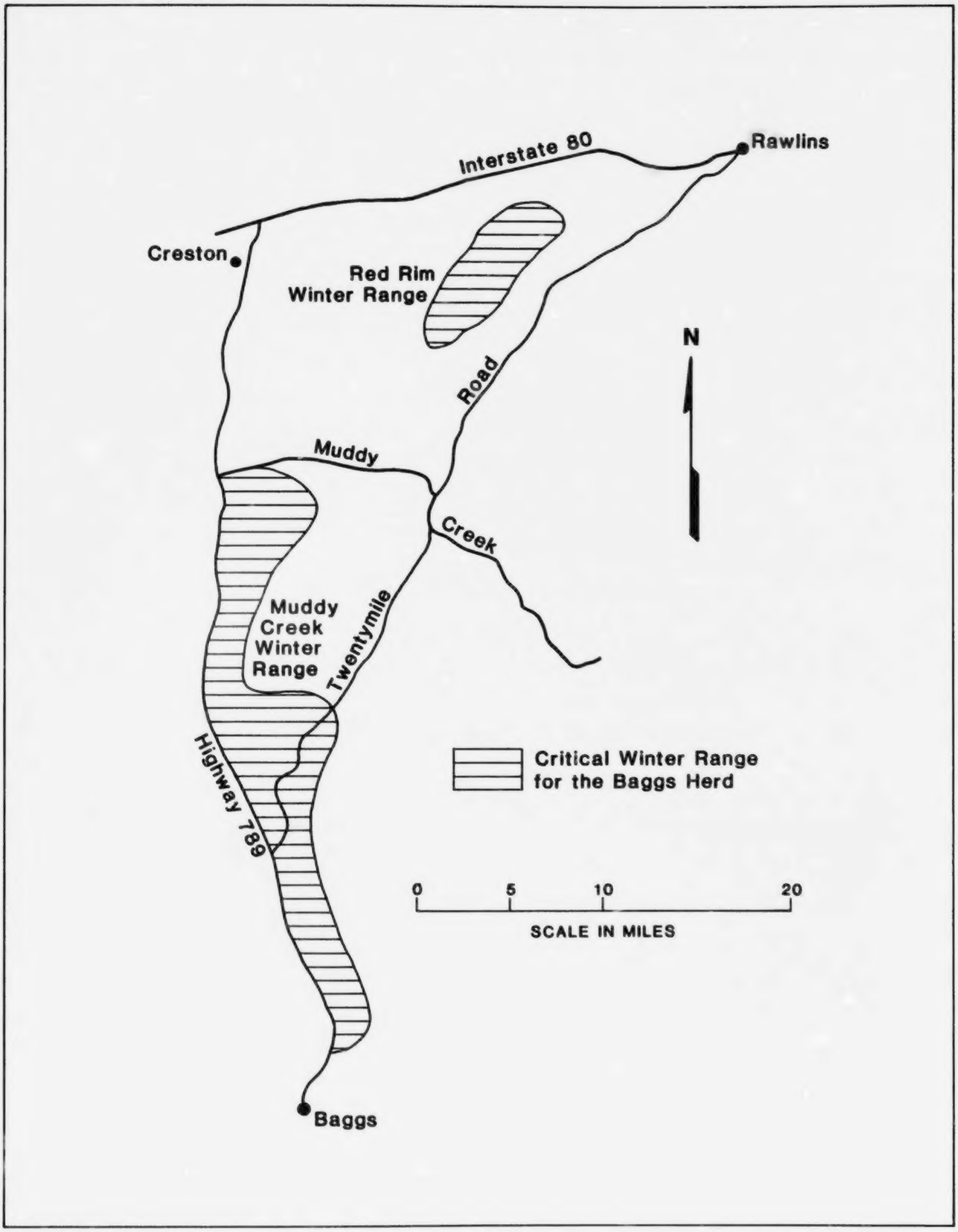

Interstate 80
Rawlins
Creston
Red Rim Winter Range
N
Road
Muddy
Creek
Muddy Creek Winter Range
Twentymile
Highway 789
Critical Winter Range for the Baggs Herd
0
5
10
20
SCALE IN MILES
Baggs

Figure II-2.--Location of the two winter ranges critical to the Baggs Herd (Wyoming Game and Fish Department, 1981a).

Wyoming GFD in its management of the Baggs Herd and are recognized to be of importance to herd maintenance on the winter range. The delineations do not imply fixed physical limitations to pronghorn movement. The pronghorn-winter range relationship is a dynamic one, and the areas used by pronghorn constantly change in size and shape. Like all living organisms, pronghorn respond to varying environmental conditions. Given free movement, pronghorn will use all available, suitable habitat, including habitat outside the critical winter range delineation. However, winter storms, snow cover, and winds all influence pronghorn movement and habitat availability.

The Red Rim range is within the Baggs data analysis unit (DAU) for pronghorn; this unit is managed by Wyoming GFD. Table II-1 shows recent population estimates by Wyoming GFD for the Baggs Herd. The herd count was estimated by multiplying actual counts, taken of pronghorn visible from the air in February or March, by a correction factor to account for animals missed during the survey.

Wyoming GFD's 1985 population management objective for the Baggs Herd, which is related to the carrying capacity of the range for the herd, is 7,200 pronghorn (Dave Moody, Wyoming Game and Fish Department, oral communication, 1985); there is no population management objective specifically for the Red Rim area, because pronghorn there are part of the Baggs Herd, not a separate and distinct population (Walt Gasson, Wyoming Game and Fish Department, written communication, September 1, 1983). The 1983-84 population estimate for the herd was 4,900 pronghorn (table II-1).

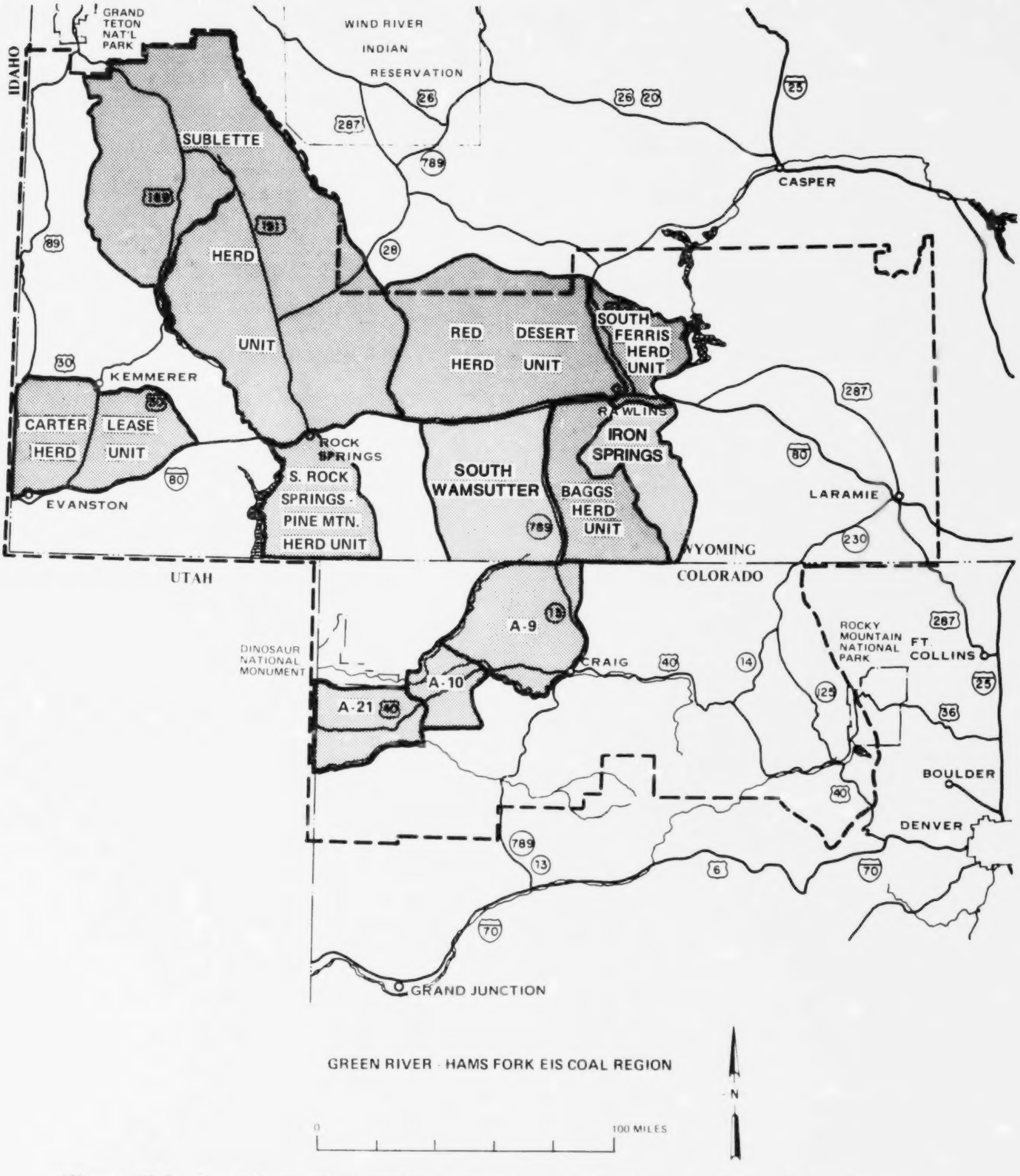
Figure II-3 shows the location of Colorado and Wyoming pronghorn herds in the immediate and general vicinity of the Baggs Herd unit; table II-2 shows the 1983 post-hunt population estimate for the Baggs Herd unit, as well as Wyoming herd units and the Colorado antelope-analysis area (A-9), which adjoins the Baggs Herd unit. The boundaries of these units (and area) are largely fixed, because little (usually less than 10 percent) interchange of animals occurs among adjacent areas/herd units. In consequence, herd units adjacent to the Baggs Herd unit do not constitute areas where Red Rim pronghorn can relocate if they are displaced by mining and reclamation. Highway fences along Interstate 80 and State Highway 789 are effective barriers to pronghorn movement west and north of Red Rim. Moreover, even if adjacent winter ranges were accessible to pronghorn, they could not support many pronghorn displaced from Red Rim. Finally, portions of these adjacent areas are being developed for coal and other energy sources, which has reduced their habitat value.

Irwin and others (1984) estimated that 700 pronghorn use the Red Rim critical winter range during the spring, summer, and fall. However, in severe winter conditions, when areas surrounding the range are covered by snow and unavailable, pronghorn from these surrounding areas move into the Red Rim range to take advantage of the shelter it offers. The areas surrounding Red Rim are used by pronghorn, but, during severe winter weather, lack the vegetational and topographic features necessary to provide shelter for this portion of the Baggs Herd (Bureau of Land Management, 1981a; Irwin and others, 1982).

Table II-3 gives the winter pronghorn population estimates for the Red Rim area. The estimated population ranges from 689 to 2,427 pronghorn; the average low and high population estimates for censuses made within the same year are, respectively, 860 and 1,722 pronghorn. This variance in pronghorn population

Table II-1.--Recent population estimates for the Baggs Herd

Year	Estimated population	Source
1977-78	11,200	Dave Moody, Wyoming Game and Fish Department, oral communication (February 1983).
1978-79	11,857	Moody (1983).
1979-80	12,151	Moody (1983).
1980-81	12,513	Moody (1983).
1981-82	12,100	Moody (1983).
1982-83	12,000	Walt Gasson, Wyoming Game and Fish Department, written communication (September 1, 1983).
1983-84	4,900	Moody (March 1985).



GRAND TETON NAT'L PARK
WIND RIVER INDIAN RESERVATION
IDAHO
SUBLETTE HERD UNIT
RED DESERT HERD UNIT
SOUTH FERRIS HERD UNIT
CASPER
KEMMERER
CARTER LEASE HERD UNIT
ROCK SPRINGS
S. ROCK SPRINGS - PINE MTN. HERD UNIT
SOUTH WAMSUTTER
RAWLINS
IRON SPRINGS
BAGGS HERD UNIT
LARAMIE
EVANSTON
UTAH
WYOMING
COLORADO
A-9
A-10
A-21
CRAIG
DINOSAUR NATIONAL MONUMENT
ROCKY MOUNTAIN NATIONAL PARK
FT. COLLINS
BOULDER
DENVER
GRAND JUNCTION
26
20
25
287
789
189
191
89
28
30
80
230
13
40
14
125
36
6
70
GREEN RIVER - HAMS FORK EIS COAL REGION
0
100 MILES
N

Figure II-3.--Locations of Wyoming pronghorn herd units and Colorado antelope analysis areas in the vicinity of the Red Rim petition area (modified from Bureau of Land Management, 1983).

Table II-2.--1983 post-hunt population estimates for the Wyoming pronghorn herd units and the Colorado antelope analysis area on and in the vicinity of the Red Rim petition area

(Sources: Harry Harju, Wyoming Game and Fish Department, written communication, 1985; Mike Albee, Bureau of Land Management, Craig, Colorado, oral communication, 1985)

Herd unit	Population estimate
Baggs	4,900
Iron Springs	12,000
South Wamsutter	7,000
South Ferris	4,500
Red Desert	5,700
A-9	4,712

Table II-3.--Pronghorn winter population estimates for Red Rim

Year	Population estimate[1]	Source
1977-78	1,120	Wyoming Game and Fish Department (1981a).
1978	719 - 1,115	Bureau of Land Management (1981a).
1978-79	1,000 - 2,427	Wyoming Game and Fish Department (1981a).
1979	689 - 1,408	Bureau of Land Management (1981a).
1979-80	1,263 1,000 - 1,300	Wyoming Game and Fish Department (1981a). Irwin and others (1981).
1980	1,875	Bureau of Land Management (1981a).
1980-81	743 - 1,183	Irwin and others (1983).
1981	1,150 - 1,197	Irwin and others (1983).
1981-82	1,150 - 1,640	Irwin and others (1983).
1983	2,073	Moody (1983).
1984	[2]800 - 2,400	Moody (1985).
1985	800	Moody (1985).

[1] The wide range of estimates for a given winter season reflects that pronghorn use of Red Rim varies widely throughout the November to April winter-count period. For example, the 1979 estimate ranges from 689 on January 5, 1979, to 1,408 on February 26, 1979. In addition, counts can vary considerably because animals move onto and off the area; they are also affected by observer experience, visibility, and snow cover.

[2] 800 to 900 pronghorn were observed on the Red Rim area at the same time an estimated 1,600 pronghorn were gathered outside a fence blocking their movement.

probably results from varying conditions, such as winter storms, snow depths, temperatures, and so forth, over the entire winter range. Estimates from the moderately severe winter of 1978-79 are that approximately 20 percent of the Baggs DAU population occupied the Red Rim portion of the winter range at the time the highest pronghorn count was made.

Dr. Larry L. Irwin (University of Wyoming, written communication, January 29, 1985) compared the quality of pronghorn wintering areas in four States (Wyoming, Montana, Colorado, and Idaho; fig. II-4). As shown in table II-4, the densities of pronghorn on Red Rim rank among the highest measured. Irwin measured pronghorn densities at Red Rim by dividing it into two portions: the south portion, including the Separation Creek and Red Rim study subareas, and the north portion, including the Central and Northest study subareas. (See figure IV-1 for a delineation of the four study subareas at Red Rim.) Assuming these divisions, Irwin ranked the south portion among the best pronghorn habitat he had examined in the four-State region; he ranked the north portion as intermediate in quality.

Both biotic and abiotic factors contribute to the suitability of the Red Rim critical winter range as habitat for pronghorn. The description that follow, of these factors and their affect on pronghorn, are based on Yoakum's (1980) pronghorn-management guidelines, which detail pronghorn habits, preferred habitats, and management considerations in broad terms. Though these guidelines were not developed for Wyoming pronghorn specifically, they do apply to pronghorn using critical winter range comparable to that found on Red Rim. Therefore, they are used here as a basis for summarizing biotic and abiotic factors as they relate to pronghorn in the petition area.

Biotic factors.--The most important biotic factor affecting pronghorn is vegetation. Pronghorn that use Red Rim year round eat grasses and forbs as well as shrubs. However, in the winter, they must have shrubs of sufficient nutritional value and availability to serve as forage. During the winter, pronghorn rely heavily on a selected group of browse species to provide them nutrition and maintain their health. BLM and Wyoming GFD established browse transects on the Red Rim critical winter range in 1979-80 (Wyoming Game and Fish Department, 1981a). The transect data they collected indicated that pronghorn browse Wyoming big sagebrush, basin big sagebrush, bud sage, saltbush, greasewood, Douglas rabbitbrush, curlleaf mountain mahagony, serviceberry, spiny hopsage, and rubber rabbitbrush.

Sundstrom and others (1973) showed that, during the winter, the percentage of browse in pronghorn diets ranges from 90 to 100 percent. Of the browse species BLM and Wyoming GFD identified, Sundstrom regards big sagebrush, particularly Wyoming big sagebrush, as the most important winter forage for pronghorn. Because pronghorn have such small digestive systems (the average pronghorn rumen is one-half the weight, and has less than two-thirds the capacity, of that of a comparably sized sheep), they must obtain the most nutritious forage available, especially in the winter.

Table II-5 (adapted from Sundstrom and others, 1973) indicates that the nutritional value of components of big sagebrush exceeds that of other browse and native grass species. The amount of protein, a vital component to pronghorn in the winter, can vary considerably among varieties of big sagebrush. Welch (1981) found that accessions within these varieties varied in crude protein content from 10 to 16 percent. Within the Wyoming big sagebrush group, crude protein varied from 11 to

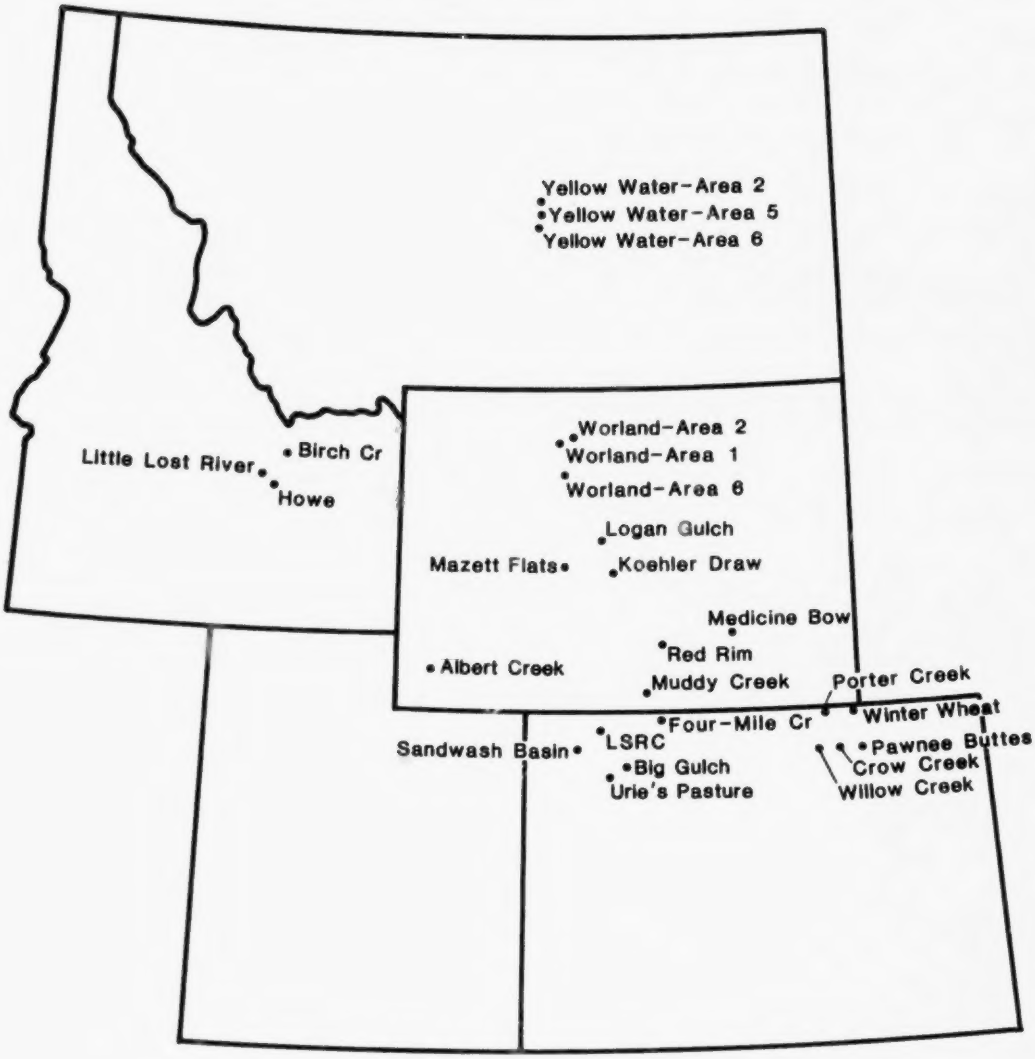

Yellow Water-Area 2
Yellow Water-Area 5
Yellow Water-Area 6
Worland-Area 2
Worland-Area 1
Worland-Area 6
Logan Gulch
Mazett Flats
Koehler Draw
Little Lost River
Birch Cr
Howe
Medicine Bow
Red Rim
Albert Creek
Muddy Creek
Porter Creek
Winter Wheat
Four-Mile Cr
LSRC
Sandwash Basin
Big Gulch
Urie's Pasture
Pawnee Buttes
Crow Creek
Willow Creek

Figure II-4.--Location of Dr. Larry L. Irwin's pronghorn winter range study sites. For purposes of this study, Dr. Irwin divided Medicine Bow, Red Rim, and Muddy Creek into two subranges. (From Larry L. Irwin, University of Wyoming, written communication, January 29, 1985.)

Table II-4.--Pronghorn densities and habitat characteristics for 28 wintering areas in Wyoming, Montana, Idaho, and Colorado

(Source: Dr Larry L. Irwin, University of Wyoming, written communication, January 29, 1985)

Wintering area	Pronghorn per mi^2	Average percentage shrub cover	Topographic index[1]
Red Rim (south), Wyoming	**53**	**17.3**	**0.98**
Muddy Creek (south), Wyoming	51	20.2	0.84
Medicine Bow (west), Wyoming	50	20.3	0.87
Medicine Bow (east), Wyoming	31	11.2	0.67
Howe, Idaho	25	17.3	0.49
Little Lost River, Idaho	23	18.6	0.55
Four-Mile Creek, Colorado	21	21.1	0.62
Red Rim (north), Wyoming	**20**	**11.3**	**0.73**
Albert Creek, Wyoming	18	15.4	0.79
Mazett Flats, Wyoming	18	11.1	0.84
Big Gulch, Colorado	14	18.8	0.76
Yellow Water Triangle (three areas), Montana	14	9.0	0.80
Sandwash Basin, Colorado	13	13.9	0.84
Uries Pasture, Colorado	12	24.6	0.67
Muddy Creek (north), Wyoming	12	18.5	0.76
Worland (area 3), Wyoming	12	16.5	0.81
Birch Creek, Idaho	11	17.3	0.48
Worland (area 1), Wyoming	11	8.6	0.81
Koehler Draw, Wyoming	10	11.0	0.74
Logan Gulch, Wyoming	10	9.0	0.69
Porter Creek, Colorado	5	2.3	0.60
Worland (area 2), Wyoming	4	1.8	0.62
Pawnee Grasslands (four areas), Colorado	1	0.5	0.55

[1] Higher values indicate more optimal topographic diversity. Minimum and maximum values of this index are 0.0 and 1.0, respectively.

Table II-5.--Comparison of nutritional values of various winter rangeland forage

(Source: Sundstrom and others (1973). Data are in percent)

Species	Total digestible nutrients	Digestible protein	Crude protein	Crude fat	Crude fiber	NFE[1]	Minerals
Big sagebrush	81.0	8.0	12.0	13.2	18.0	52.0	4.2
Saltbush	33.4	--	13.8	1.6	22.1	38.8	17.2
Rabbit-brush	--	--	8.5	10.5	32.0	44.5	3.8
Bitter-brush	47.3	2.3	6.4	4.5	20.0	56.5	2.0
Mature, dried pasture grass	51.9	1.4	5.1	2.5	35.2	50.0	6.5
Weathered, dried pasture grass	45.6	0.2	3.6	2.0	37.6	49.1	6.9

[1] NFE = nitrogen free extract, here refering only to soluble carbohydrates. Unsoluble carbohydrates are fibrous and, therefore, less digestible.

12.9 percent. Welch also reported that mule deer selected some accessions of big sagebrush over others, indicating a palatability difference among accessions. It is not known if Welch's work can be directly applied to pronghorn.

The importance of Red Rim's draws for providing food and shelter to wintering pronghorn has been established. During the winter of 1979-80, following heavy snowfall, pronghorn concentrated first along Separation Creek (in draws), where taller big sagebrush were available, and then, when the creek bottom became too crowded, on windswept benches supporting shorter sagebrush. Thus, in addition to their nutritional composition, the distribution, size, and density of the big sagebrush on Red Rim are increasingly important as winter conditions worsen (Irwin and others, 1984). Because winter storms vary in duration and intensity, the extent and accessibilty of suitable forage also vary. The complex mosiac of suitable forage on Red Rim enables pronghorn to survive these changing winter conditions.

Abiotic factors.--Topography is the most crucial abiotic factor in the value of a site as winter range (Bruns, 1977; Sundstrom and others, 1973; Irwin and others, 1983). Topography influences soil development, the distribution and redistribution of moisture, and the extent to which an area will be protected from the wind; it also affects plant distributions and snow accumulations. During the winter, pronghorn must obtain nutritional forage and minimize their loss of energy by restricting their movements and their exposure to severe wind. The diversity of slopes and exposures on Red Rim provide the mixture of windswept and sheltered areas ideal for pronghorn. Irwin and others (1984) found that snowfree benches and ridges were increasingly selected by pronghorn as winter severity increased.

A secondary abiotic factor in the value of the Red Rim site as critical winter range is the availability of water on it. Pronghorn commonly use snow for water during the winter, but Irwin and others (1984) found that, during January and December of 1981, pronghorn concentrated near a flowing well. Irwin and others did not speculate as to whether or not this 1981 finding indicated that pronghorn prefer open water; however, they did find that one characteristic of habitats unused by pronghorn was that they were long distances from open water.

B. TOPOGRAPHY

The most prominent topographic feature of the petition area is the Red Rim escarpment that trends northeast-southwest along the southeast edge of the petition area. The escarpment is about 300 to 400 feet high along its southeast face, with a gentle backslope to the northwest. This northwest facing hillslope is cut by a number of valleys and draws which are tributary to Separation Creek, the major drainage in the area.

The erosion of siltstones and shales within the Fort Union Formation has created the upland ridges along the indurated sandstone beds within the petition area. Between these uplands and Separation Creek are numerous valleys and draws of moderate gradient. Some of these draws are moderately entrenched and fairly steep sided in their upper reaches. The majority of the upper reaches, including those in the vicinity of the Red Rim escarpment and the escarpment itself, would not be mined, because they fall within BLM's proposed no surface occupancy areas. The downslope areas are gently rolling with many broad, nearly flat areas up to 20 acres in size. In general, the northwest facing hillslopes have a lower gradient than the dip of the underlying sandstones.

Two rugged, highly eroded areas occur within and immediately adjacent to the petition boundary--one where Separation Creek cuts through Red Rim (T. 19 N., R. 90 W., sec. 9) and the other at the northeast end of the petition area (T. 21 N., R. 89 W., secs. 24, 26, and 35).

The altitude of the petition area ranges from about 7,400 feet above sea level along Red Rim to about 6,700 feet above sea level toward the northern end of the northwest boundary.

C. VEGETATION

A large portion of the Red Rim site is dominated by shrubs from the salt desert shrub (saltbush (*Atriplex* sp.) and greasewood (*Sarcobatus vermiculatus*) and the northern desert shrub (sagebrush (*Artemisia* sp.) and rabbitbrush (*Chrysothamnus* sp.)) types. These shrubs, which serve as forage for wildlife and which prevent erosion in the existing landscape, are the most important physiognomic type of vegetation within the petition area. They dominate the cover and production of many of the plant communities. Grasses are wide-spread on the site, but they dominate fewer of the plant communities and are poorly represented by the number of species present. The cover values and productivity of the grass species on the Red Rim site are far less than for areas in excellent range condition. The dominant grass species include Western wheatgrass (*Agropyron smithii*), bluebunch wheatgrass (*Agropyron spicatum*), thickspike wheatgrass (*Agropyron dasystachyum*), giant wildrye (*Elymus cinereus*), Indian ricegrass (*Oryzopsis hymenoides*), and needle-and-thread (*Stipa comata*). Forbs found on Red Rim include aster (*Aster* sp.), daisy (*Erigeron* sp.), wild buckwheat (*Eriogonum* sp.), and Hoods phlox (*Phlox hoodii*). Appendix E gives a quantitative description of some of the vegetation communities or assemblages within the petition area.

Several factors influence the distribution of plant communities on the petition area. The long northeast- to southwest-trending ridge system that dominates the topography of the area is controlled by the outcrop of the more indurated strata, generally carbonate-cemented sandstones, from the Fort Union Formation. The ridge system has had a significant impact on the redistribution of precipitation, on the development of soils through erosion and subsequent deposition of sediment, and on the plant communities. Greatly enhanced biomass production occurs in depositional areas because of the much higher amount of effective moisture and more productive soils there. Edaphic factors, such as texture, exchangeable sodium percentage, soluble salts, pH, available water-holding capacity, infiltration and percolation rates, and soil depth, are all critical to the distribution of plant communities on this site. The long ridge system that dominates the area has been eroded by channels that run generally northwest, perpendicular to the main system, forming a complex series of ridges, draws, escarpments, swales, and basins that tend to trap snow. Branson (Bureau of Land Management and others, 1976) noted the importance of snow distribution to the presence of basin big sagebrush (*Artemisia tridentata* Nutt. ssp. *tridentata*). A subtype of the plant community dominated by basin big sagebrush is consistently found in areas that accumulate snow in the uplands. Corresponding changes in the soil system have taken place, reflecting the increase in both the effective moisture and the biomass production. Owing to increased livestock use in the proximity of water, plant communities and associated species near Separation Creek have been influenced to a much greater extent than those in the breaks near the Red Rim escarpment.

The two major shrub formations occurring on the Red Rim petition area are the salt desert shrub and the northern desert shrub types. Salt desert shrubs, which occur primarily south and west of Wyoming, are generally characterized as halophytes. Descriptions by Shantz and Zon (1924) of both the salt desert shrub and the northern desert shrub formations are used in discussing floristic elements of the western United States. Table II-6 gives the classification system developed by Shantz (1925) for these two formations. The salt desert shrub formation is frequently, but not always, associated with soils of moderately high and high levels of salinity and/or alkalinity, although situations exist where there are lesser quantities of salts/sodium involved. The formation occurs on less sodic and/or alkaline soils if these contain large amounts of clay, particularly expanding lattice clays. Such soils generally exhibit soil-moisture stress and reduced available soil moisture for plants. Branson (1967) developed a scheme for classifying vegetation based on osmotic stress in the soil system (table II-7). Classification systems developed by Fautin (1946), Shreve (1942) and Billings (1949) are presented in tables II-8, II-9, and II-10; these systems describe the characteristics of the existing plant communities in the Red Rim petition area and the potential for their reestablishment.

Appendix E compares quantitative data regarding some of the shrub types occurring on the petition area (Bureau of Land Management and others, 1976; Rocky Mountain Energy Company, 1982b) with data from other areas in the Hanna Basin (Bureau of Land Management and others, 1975; Arch Mineral Corporation, 1981b).

RME's vegetation characterization study of the Red Rim area (Rocky Mountain Energy Company, 1982b) includes an inventory primarily of shrub types in the petition area. The identified communities include sage, sage-grass, grass, saltbush, greasewood, mountain shrub, riparian, meadow, and barren. OSM calculated the acreages of each of these vegetation types for six representative sections of the petition area. (See appendix E.)

A description of RME's vegetation survey methodology is given in appendix D. The vegetation study was designed to obtain browse cover and density data on pronghorn and sage-grouse habitat. Because the scope of the study was limited, the data are not detailed enough to fully characterize the existing plant communities. For example, the mapping units or vegetation types are not defined in terms of cover, frequency, or production for all species; RME describes the communities only in terms of shrubs except for the production studies where it clipped only the forbs and grasses, utilizing composite sampling techniques. A combination of methods and procedures--line transect and two different quadrat sizes--limits the potential for comparison of the data from the units recognized on the site with other sites or studies.

Separation of the subspecies of big sagebrush (Artemisia tridentata; see table II-11) is important in characterizing all of the vegetation types in the Red Rim area because of the differing importance of each to pronghorn and livestock utilization (Beetle, 1977), and because of the need to develop a fundamental understanding of the characteristics of the plant communities and the factors influencing their distribution in the landscape. With reference to its pronghorn

Table II-6.--Classification system for vegetation of the Great Basin

(Source: Shantz, 1925)

Northern Desert Shrub Formation:

- Sagebrush association (*Artemisia tridentata*)
- Small sagebrush association (*Artemisia nova*)
- Little rabbitbrush associes (*Chrysothamnus puberulus*)
- Shadscale association (*Atriplex confertifolia*)
- Winterfat associes (*Eurotia lanata*)
- Hop-sage and Celeogyne association (*Grayia spinosa* and *Coleogyne ramosissima*)
- Bud sagebrush association (*Artemisia spinescens*)
- Mat saltbush association (*Atriplex corrugata*)
- Gray molly association (*Kochia vestita*)

Salt Desert Shrub (Greasewood) Formation:

- Greasewood association (*Sarcobatus vermiculatus*)
- Greasewood shadscale association (*S. vermiculatus* and *Atriplex confertifolia*)
- Seepweed association (*Dondia torreyana*)
- Pickleweed association (*Alburofea occidentalis*)
- Samphire association (*Salicornia utahensis* and *S. rubra*)
- Saltgrass associes (*Distichlis stricta*)
- Alkali sacaton associes (*Sporobolus airoides*)
- Rabbitbrush associes (*Chrysothamnus graveolens*)

Table II-7.--System for classifying vegetation in the intermountain shrub region, based on osmotic stress

(Source: Branson, 1967)

Zone and community	Osmotic stress at field capacity atmospheres
Sagebrush zone:	
Little rabbitbrush community (*Chrysothamnus viscidiflorus*)	0.01
Big sagebrush community (*Artemisia tridentata*)	0.1
Black sagebrush community (*Artemisia nova*)	0.2
Salt Desert Shrub zone:	
Bud sagebrush community (*Artemisia spinescens*)	----
Winterfat community (*Eurotia lanata*)	0.6
Shadscale community (*Atriplex confertifolia*)	2.2
Desert molly community (*Kochia americana*)	3.2
Greasewood community (*Sarcobatus vermiculatus*)	5.0
Nuttall saltbush community (*Atriplex nuttallii*)	5.0
Mat saltbush community (*Atriplex corrugata*)	----

Zone and community	Osmotic stress at saturation atmospheres
Salt Marsh zone:	
Rabbitbrush community (*Chrysothamnus nauseosus*)	1.5
Alkali sacaton community (*Sporobolus airoides*)	2.8
Saltgrass community (*Distichlis stricta*)	16
Seepweed community (*Suaeda torreyana*)	23
Glasswort community (*Salicornia utahensis* and *S. rubra*)	35
Pickleweed community (*Allenrolfea occidentalis*)	35
Algae	50
Fungi	75

Table II-8.--Bioecologic classification of Great Basin vegetation

(Source: Fautin, 1946)

- Pinon-Juniper Biome
- Northern Desert Shrub Biome:
  - Shadscale Community
  - Tetradymia Community
  - Greasewood Community
  - Winterfat Community
  - Black Sage Community
  - Pickleweed Community
  - Little Rabbitbrush Associes
  - Sagebrush Community
- Southern Desert Shrub Biome

Table II-9.--Classification of Great Basin Desert vegetation

(Source: Shreve, 1942)

- Great Basin Desert:
  - *Juniperus Utahensis* (6,000 to 7,000 feet)
  - *Artemisia tridentata* (upper belt)
  - *Atriplex confertifolia* (lower belt)
  - *Kochia vestita*
  - *Sarcobatus vermiculatus*
  - *Distichlis stricta*-*Sporobolus airoides*
  - *Salicornia rubra*
  - *S. utahensis*
  - *Allenrolfea occidentalis*
  - *Coleogyne ramosissima*

Table II-10.--Billing's zonation concept applied to Great Basin vegetation

(Source: Billings, 1949)

- Sagebrush zone
- Shadscale zone:
  - Edaphic climaxes in zone:
    - Greasewood
    - Greasewood-shadscale
    - Pickleweed
    - Winterfat
  - On dune sands:
    - *Dalea polyadenia*-*Tetradymia glabrata*
    - *Chrysothamnus stenophyllus*

Table II-11.--Characterization of the three subspecies of Artemisia tridentata

(Source: Modified from Beetle and Young, 1965)

Subspecies tridentata	Subspecies wyomingensis	Subspecies vaseyana
Basin big sagebrush	Wyoming big sagebrush	Mountain big sagebrush
The common big sagebrush at 5,000 feet or below.	The most common big sagebrush in Montana, Wyoming, and northern Colorado at 5,000 to 7,000 feet.	The common big sagebrush at 7,000 feet and above.
No tendency to layer.	No tendency to layer.	Strong tendency to layer.
Dry, deep-soil sites.	Dry, shallow-soil sites.	Deep-soil snowfall areas of mountain slopes.
Heads few-flowered.	Heads intermediate.	Heads many-flowered.
Heads paniculate.	Heads intermediate.	Heads spikate.
Leaves narrowly lanceolate.	Leaves narrowly cuneate.	Leaves broadly cuneate.

browse-utilization study, RME (1982a) acknowledged the important differences among the varieties: "In addition, *A. tridentata wyomingensis* is found more often in the sagebrush-grass type and *A. tridentata vaseyana* or some other subspecies in the sagebrush type. *A. tridentata wyomingensis* appears to be a more preferred species." (OSM suspects, based on the habitat in which the specimen was collected, that the *A. tridentata* ssp. *vaseyana* was probably *A. tridentata* ssp. *tridentata*.) Unfortunately, in the Red Rim vegetation characterization study (Rocky Mountain Energy Company, 1982b), RME recognized the two critically important and most widespread subspecies of big sagebrush--basin big sagebrush and Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis* Beetle and Young)--only in the riparian vegetation type. Though not mentioned in RME's study, mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana* (Rydb.) Beetle) is also suspected to be in the area; if present, it would occur on the higher elevations of the tract (Beetle and Johnson, 1982).

Based on their review of the literature and their 1983 field examination of the petition area, including the critical winter range, OSM believes that the sage vegetation type for the area should, at minimum, be separated into mapping units or community types as follows:

- Basin big sagebrush
- Basin big sagebrush and Wyoming big sagebrush
- Basin big sagebrush and greasewood (*Sarcobatus vermiculatus*)
- Basin big sagebrush, Wyoming big sagebrush, and greasewood
- Wyoming big sagebrush
- Wyoming big sagebrush and greasewood
- Wyoming big sagebrush and Gardner saltbush (*Atriplex gardneri*)
- Black sagebrush (*Artemisia nova*)

OSM identified these mapping units or community types only in terms of the shrub(s) that dominate them; commonly, community types are identified in terms of both the shrub(s) and the grass(es) that dominate them (Elliott, 1981; Prodgers, 1983; Daubenmire, 1966; Thilenius, 1972). In addition, the types were defined based only on field observations; data from the site should be evaluated prior to mapping with such units (Becking, 1957; Braun-Blanquet, 1932; Curtis, 1959; Mueller-Dombois and Ellenberg, 1974; Whittaker, 1962). The basic point of concern is not the nomenclature used to describe the vegetation type but, rather, the level of vegetation characterization used to describe the mapping unit and the detail used in delineation of types in the field.

In 1976, BLM established an Energy Mineral Rehabilitation Inventory Area (EMRIA) at Red Rim (Bureau of Land Management and others, 1976). This EMRIA study area covers 4.12 sections in T.19 N., R. 90 W., secs. 4, 8, and 18, and in T. 20 N., R. 90 W., sec. 34 and SE¼ sec. 28; it comprises portions of the Red Rim petition area that would be mined. Although BLM's report on this area does not represent or describe all the plant communities that occur within the petition area, and the samples BLM took in the area probably do not meet sample adequacy tests currently being used, the report is useful, because standardized methods were used throughout, and the data collected can be compared with data from other studies done on similar vegetative types. Certain of BLM's EMRIA data, as well as data from the Arch Mineral Corporation's Seminoe No. 2 mine permit application (Arch Mineral Corporation, 1981a; 1981b), have been included in the discussion of the vegetation types at Red Rim (appendix E). The Seminoe No. 2 data were included because climatic regimes, topography, and to a limited extent the soils at that minesite are similar to those at the Red Rim petition area.

Routine vegetation evaluations associated with the BLM Soil Vegetation Inventory Method (SVIM) and additional work to determine range condition and carrying capacity have been done in the area. These studies are based on the range-site condition class system developed by Dyksterhius (1949, 1952, 1958a, b). Such work first involves the correlation of soil mapping units and/or series with range sites followed by the determination of condition classes and carrying capacities. The data collected are primarily those of yield or production for the year and are of only limited value in characterizing the vegetation resources on the site. The data have not been summarized by BLM and thus were not available for inclusion in this analysis.

D. SOILS AND OVERBURDEN

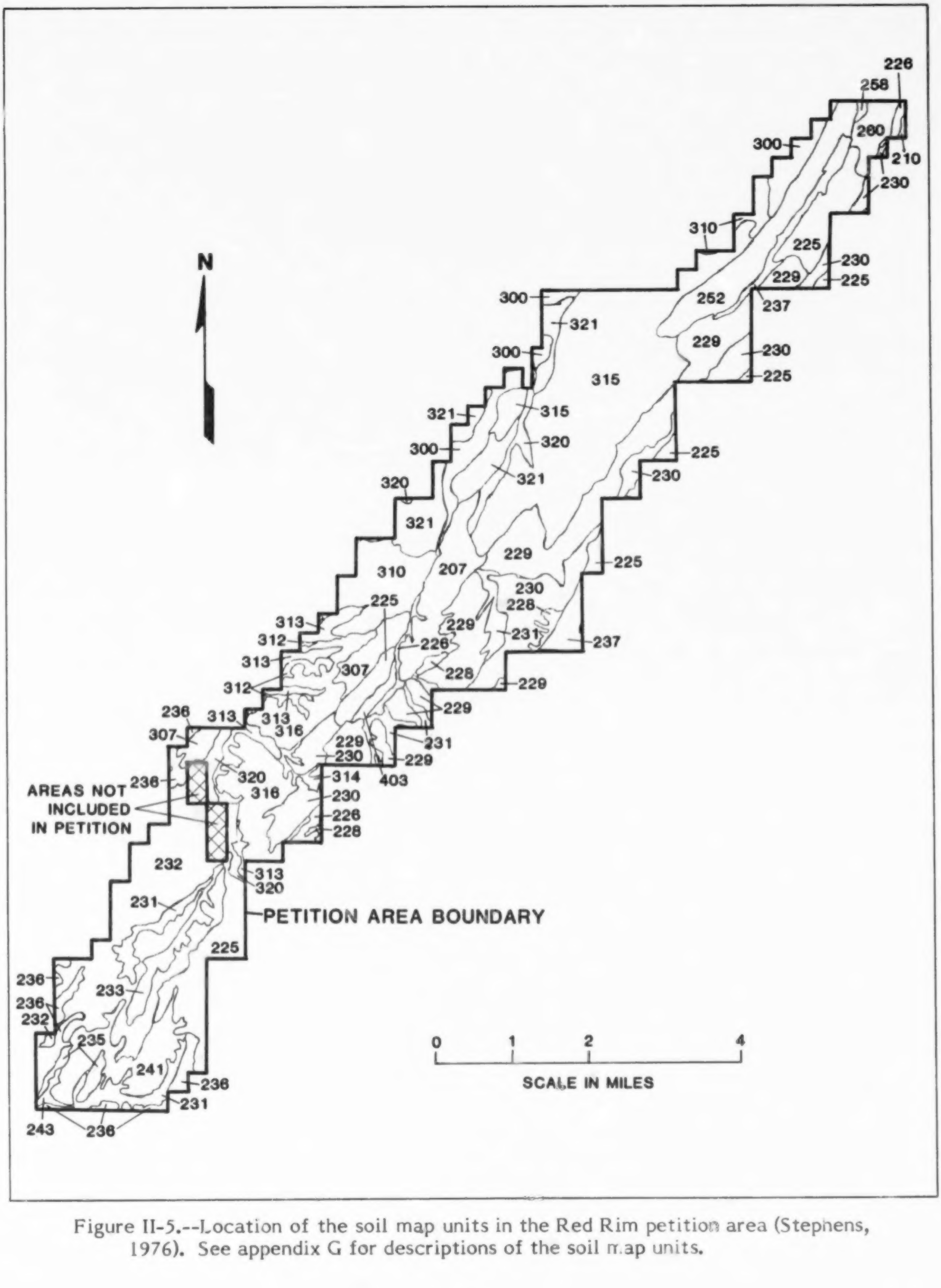
The depth, texture, profile morphology, and slope of soils in the petition area vary considerably, owing to diverse topography, widely differing parent materials in the area, and the range in effective precipitation. Parent materials for soils in the area include calcareous sandstone, shale, colluvium, and alluvium. Figure II-5 is an Order 3 soil-inventory map of the Red Rim tract. Soil mapping-unit descriptions are in table G-1 of appendix G.

Approximately 31 percent of the soils in the petition area are deep (over 40 inches), 37 percent moderately deep (20 to 40 inches), 24 percent shallow (10 to 20 inches), and 2 percent very shallow (less than 10 inches). (See appendix G.) The remaining 6 percent of soil mapping units are made up of sandstone and rock outcrops and ledges, and sands and very shallow soils associated with these (Stephens, 1976).

About 2,000 acres of the deep soil components of map units 210, 225, 226, 231, 258, 260, 300, 310, 313, and 320 have sodium adsorption ratios (SAR's) above 13 at some depth in their profiles. Soils with SAR's above 13 are generally not suitable for reclamation by vegetation that is sodium sensitive (Bud Holbrook, Area Manager, Bureau of Land Management, Rawlins District, written communication, February 23, 1983).

The surface texture of the soils in the petition area ranges from clay to fine sand; however, most of the soils have a loam surface texture. Specifically, about 43 percent of the soils have a surface texture of loam, 28 percent of sandy loam, 10 percent of loamy sand, 8 percent of silty clay loam, 6 percent of rock and sandstone outcrop and associated inclusions, 3 percent of fine sand, 1 percent of clay loam, and 1 percent of clay (Stephens, 1976).

BLM found that approximately one-third of its EMRIA study area for Red Rim has potential reclamation problems, owing to the shallow depths of weathered material over shale and sandstone, the salinity and coarse texture of the soils, the



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AREAS NOT INCLUDED IN PETITION
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PETITION AREA BOUNDARY
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SCALE IN MILES

Figure II-5.--Location of the soil map units in the Red Rim petition area (Stephens, 1976). See appendix G for descriptions of the soil map units.

steep slopes, and pervasive bedrock outcrops which hinder topsoil salvaging in the area (Bureau of Land Management and others, 1976). It also found that bedrock in the 4.12-section study area is largely sandstone and shale, ranging from quite thickly bedded to highly interbedded (Bureau of Land Management and others, 1976). Siltstone and seams of coal and carbonaceous shale were found to occur less frequently. Some of this bedrock constitutes inadequate planting media, anticipated to weather into fine- or coarse-textured material; some is dense unweatherable sandstone; some is saline and/or acidic at some depths (Bureau of Land Management and others, 1976).

Most of the harmful concentrations of salinity and sodicity occur in the shales. Moreover, weathered sandstone could yield a coarse-textured material, which has a low cation exchange, high permeability, and a low water-holding capacity. Also, many of the more dense sandstones may not weather in time to serve as suitable planting media. In general, the core material is nonsodic and nonsaline except for a few lenses, which have an electrical conductivity (EC) ranging between 4 and 6 micromhos per centimeter (mmhos/cm). The material appears to have a relatively low swell factor. Except for a 30-foot acidic seam, the bedrock is neutral to alkaline (Bureau of Land Management and others, 1976).

E. LAND USE

The petition area is currently used for livestock grazing and wildlife habitat. Four grazing allotments fall each partially within the area, where, together, they yield livestock forage of about 2,430 animal unit months (AUM's) per year (Bureau of Land Management, 1981b). The past actual usage of these AUM's within the petition area is not known. However, 1984 data for the three major allotments covering the area indicate that an average of 40 percent of the total available AUM's were used that year (Doug Powell, Bureau of Land Management, oral communication, 1985). The area is used by up to 2,400 pronghorn. (See section IIA for a more detailed discussion of pronghorn use of Red Rim.)

Rights-of-way through the area include four pipelines, one railroad, and four power, telegraph, or telephone lines. Most of the rights-of-way are concentrated near Interstate 80 at the northern tip of the petition area.

F. RECREATION

The primary recreational use of the Red Rim petition area is for hunting pronghorn and mule deer. The South Rawlins and Baggs Hunt Areas comprise the Baggs Herd Unit. Red Rim is within the South Rawlins Hunt Area. In 1981, an estimated 1,030 to 1,390 licenses to hunt pronghorn were sold in the Baggs and South Rawlins Hunt Areas. For that same year and area, 320 mule-deer licenses were sold (Wyoming Game and Fish Department, 1981b). Secondary recreational uses of the petition area include sightseeing, off-road vehicle use, and small game hunting.

Medicine Bow National Forest, some 60 miles southeast of Rawlins, is used recreationally for fishing, camping, cross-country skiing, and snowmobiling. The Seminoe Reservoir and North Platte River provide water-related recreational opportunities.

Both Rawlins and Carbon County maintain recreational facilities, although their indoor facilities are limited. The Rawlins Parks and Recreation Department is managed by a full-time director who is responsible for the maintenance and development of the city's seven parks. Approximately 44 acres of developed open space and 58 acres of undeveloped land are available for recreation in Rawlins. These park facilities adequately serve the existing population (Don Bessler, Rawlins Parks and Recreation Department, oral communication, March 1983).

G. GEOLOGY

The Red Rim petition area is on the south flank of the Wamsutter Arch and west of the Rawlins uplift. The geologic units in the petition area are, in ascending order, the Mesaverde Formation, the Lewis Shale, the Lance Formation, and the Fort Union Formation (fig. II-6). Dips in the formations within the petition area range from 24 degrees (°) along Red Rim to 6° near Separation Creek (Sanders, 1974). In the upper part of the Fort Union Formation, most outcrops are sandstones which dip more steeply than do the underlying shales and coal beds. The strike of the beds is northeast-southwest, and the dip is northwest.

The Mesaverde Group comprises more than 2,500 feet of sandstone, shale, and coal. Sandstone beds are as much as 120 feet thick and constitute more than half the formation. These resistant beds form the Atlantic Rim escarpment to the east. Most of the sandstone is very fine to fine grained (Berry, 1960).

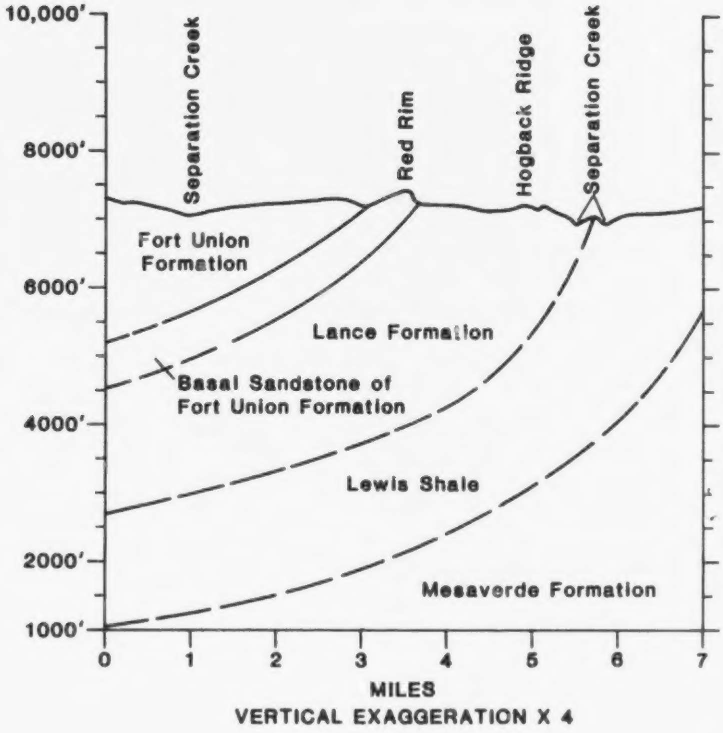
The Lewis Shale consists of about 2,000 feet of dark gray fissile shale grading to buff sandy shale (Sanders, 1974). Lenses of gray to buff, sandy, calcareous siltstone, and dark gray to brown carbonaceous material are interspersed in the formation. Thin bentonite beds and brown sandstone concretions are common.

The Lance Formation is composed of a maximum of almost 4,000 feet of interbedded light gray sandstone and medium to dark gray and gray-green shale. The lower half of the formation includes several beds of coal, some of which have been mined in T. 20 N., R. 88 W. (Sanders, 1974). Sandstone beds near the base of the Lance form the prominent Hogback Ridge escarpment just east of the area.

The Fort Union Formation comprises almost 3,500 feet of sandstone, conglomerate, siltstone, shale, and coal. The basal sandstone of the Fort Union is 500 to 600 feet thick (Sanders, 1974) and forms the Red Rim. Although the basal sandstone is light gray, it weathers pink, red, or brown. It is a thick-bedded to massive medium- to coarse-grained crossbedded sandstone. Chert-pebble conglomerates are interspersed in the bed, and, locally, dark gray shale separates sandstone layers.

Colluvium is very widespread throughout the area and consists of weathered bedrock detritus. Alluvium underlies the floodplain of Separation Creek and some of its tributaries. Most of the alluvium is silt or clay, but sand and gravel occupy the deeper parts of the alluvial deposits. Alluvium is as much as 22 feet thick along Separation Creek.

The Red Rim area is not known to contain any active faults (Witkind, 1975) and southcentral Wyoming is considered to be an area of low seismicity (Simon, 1972; Algermissen and Perkins, 1976).


10,000'
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Separation Creek
Red Rim
Hogback Ridge
Separation Creek
Fort Union Formation
Lance Formation
Basal Sandstone of Fort Union Formation
Lewis Shale
Mesaverde Formation
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5
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MILES
VERTICAL EXAGGERATION X 4

Modified from Larson and Zimmerman

Figure II-6.--Schematic of a geologic cross-section in the vicinity of the Red Rim petition area (Larson and Zimmerman, 1981).

The Fort Union is susceptible to landsliding where slopes are steep or where materials derived from it are piled (Barclay and Blanchard, 1981). The formation contains rocks (claystone, mudstone, and their fissile equivalents) in which clay minerals are the major or the only constituents and in which swelling clays comprise a significant proportion of the clay minerals present (Barclay and Blanchard, 1981). Some of the sandstones in the formation contain clay minerals as matrix or binder, and in thin beds or laminae. Given the semiarid nature of the area, most existing slopes (except, perhaps, on the east side of the Red Rim) are generally not steep enough to induce landsliding (Barclay and Blanchard, 1981).

The coal seams proposed to be leased (see plate 1, in pocket) are part of the lower Fort Union Formation. There are 12 seams which can be mined. These seams range from 2 to 38 feet thick; most seams average 5 to 12 feet thick. If all 12 seams were to be mined, an estimated 72 million tons of coal could be recovered from the petition area. The coal has an average of 0.45 percent sulfur and yields an average of 8,560 Btu/lb. Chapter III gives further information on the coal resources of the petition area.

There are no producing oil or gas wells within the petition area; however, the area does contain portions of 21 oil and gas leases (Bureau of Land Management, 1981b).

H. CLIMATE

The climate of the Red Rim petition area is semiarid. Air masses from the Pacific Ocean lose most of their moisture in the mountains to the west of the area and moisture from the Gulf of Mexico seldom reaches as far north. Therefore, mean annual precipitation at the petition area is less than 11 inches. Deep cold air masses from Canada occasionally reach the area from the northwest, but shallow cold air masses rarely reach the area.

The nearest weather station is at Rawlins, Wyoming, about 15 miles northeast of, and 400 feet lower in elevation than, the petition area. Nevertheless, records from this station of the climate at Rawlins are representative of the climate at the petition area.

Mean annual precipitation at Rawlins is 10.43 inches; the wettest months are April, May, and June, for which precipitation totals 3.40 inches. Precipitation during the late fall and winter months (October through March) averages less than 0.6 inches per month; most of this falls as snow. The mean annual snowfall at Rawlins is 42 inches or about 40 percent of the annual precipitation. RME's precipitation gages measured 8.51 and 8.55 inches of precipitation, during 1981 and 1982, respectively, at the Red Rim reclamation test plot. These values are probably low by as much as 20 percent because the gages were not shielded.

The mean annual temperature at Rawlins is 43°F. The mean monthly temperatures are:

January	22°F	May	50°F	September	56°F
February	24°F	June	61°F	October	44°F
March	30°F	July	68°F	November	32°F
April	41°F	August	66°F	December	24°F

The growing season is approximately 90 days, extending from about June 2 to about August 30.

Average annual wind speed is high (12 miles per hour (mi/h)). Winds are stongest in winter and spring, when they gust up to 40 mi/h or more. The prevailing winds are from the west and southwest.

I. AIR QUALITY

The air quality in the Red Rim petition area is generally very good. In 1978, mean total suspended particulate (TSP) concentrations measured 17.3 micrograms per cubic meter ($\mu g/m^3$) at Adams Ranch, approximately 10 miles west of the petition area, and 27.3 $\mu g/m^3$ at Espy Ranch, approximately 10 miles northeast of the petition area. Atmospheric conditions in the area are, in large part, neutral. However, temperature inversions occur on cool mornings, but these normally dissipate by afternoon. Visibility at Rawlins Airport, 10 miles from the area, is very high, averaging 26.8 miles annually. According to provisions of the Clean Air Act, the Red Rim petition area is classified as a Class II prevention of significant deterioration air-quality area. Thus, the amount of air pollution allowed in the area is constrained by law. There are no "non-attainment" areas (that is, areas where air quality is currently in violation of National Ambient Air Quality Standards) or "air-quality maintenance" areas (areas in which, owing to the current air quality and/or projected growth rate, air quality may exceed any National standard within the next 10 years) near the tract. Moreover, no major sources of air pollutants exist near Red Rim.

J. SOCIOECONOMICS

The local governments that would be primarily affected by development of the Red Rim petition area are those of Carbon County, the city of Rawlins, and Carbon County School District No. 1. Creston Junction, Sinclair, and Saratoga, in the general vicinity of the site, would experience minimal, secondary impacts.

Carbon County and the city of Rawlins are typical of sparsely populated rural areas in Wyoming that have grown rapidly as the result of energy development. The population of Carbon County increased approximately 45 percent over a 12-year period, from 13,354 in 1970 to an estimated 19,388 in 1982. Rawlins's population increased approximately 41 percent, from 7,855 in 1970 to an estimated 11,082 in 1982.

Despite past increases in population, far less growth for these two local governments is projected for the 1980's and 1990's, owing, in large part, to the decreasing current and anticipated markets for Carbon County energy resources.

(Demographic changes with and without a mine at Red Rim are discussed in chapter IV and are shown on table IV-8.)

Carbon County's economy depends heavily on the coal market. In 1980, over 34 percent of the county's labor force was employed by the coal-mining industry. From 1973 to 1978, the county's labor force grew nearly 50 percent, from 6,141 to 9,240. In 1981, the county's unemployment rate averaged 3.6 percent. However, by December 1982, this rate had increased to 10.9 percent, mainly owing to a soft market for coal and uranium, leading to layoffs of energy-related construction and operation workforce personnel.

Total disposable personal income in the county increased over 300 percent in 10 years, from $40 million in 1970 to $176 million in 1980. Per capita income increased during the same period from $3,535 to $9,487.

The number of dwelling units in Rawlins increased 44 percent between 1970 and 1980, from 2,771 to 4,015 (Carbon County Council of Governments, 1980). In 1980, 59 percent of these units were single-family, 17 percent were multi-family, and 22 percent were mobile homes. In 1980, the vacancy rate for single-family units (including mobile homes) and multi-family units was approximately 3 percent; almost no rental units were vacant at that time. As of 1983, owing to the outmigration of energy-dependent population, vacancy rates were approximately 30 percent for single-family (including mobile homes), multi-family, and rental units combined (David Spencer, Rawlins City Planning Department, oral communication, March 18, 1983). There is no shortage of available building spaces in Rawlins.

In the past, the major growth-related problems facing Rawlins included the increased need for wastewater treatment facilities, school facilities, administrative space, and housing. Both the county and city have taken aggressive measures to meet these needs. Capital improvements undertaken since 1980 include:

- Renovation of the Carbon Building to house county and city administrative facilities. Renovation was completed in 1982 at a cost of $1.7 million.

- Securing of funds for construction of a $3.5 million waste-treatment facility designed to serve a population of 25,000. Construction of this facility began in 1983.

- Construction of a new elementary school designed to accomodate an enrollment of up to 450 students. Rawlins has also substantially improved Rawlins High School. In 1980, voters passed a $7.2 million bond to pay for building the elementary school and making improvements to the high school (David Spencer, Rawlins City Planning Department, oral communication, March 18, 1983).

Rawlins is developing long-term water supplies and is rectifying structural problems with the Altantic Rim Reservoir, a major source of its water.

As a result of the recession, Rawlins has reduced its local governmental staff by 40 percent, mainly through attrition. In 1982, both the city and the county were operating with a net surplus budget. As of 1983, projections were that the city's revenues would drop slightly between 1983 and 1985 but would begin to rise steadily by 1986 (David Spencer, Rawlins City Planning Department, oral communication, March 18, 1983).

Additional information on the existing social and economic characteristics of the area to be primarily impacted by development of the Red Rim site is given in the Green River-Hams Fork regional coal EIS and the BLM profile and site-specific analysis of the Red Rim tract (Bureau of Land Management, 1980, 1981b) as well as in Carbon County Planning and Development Department (1983).

K. HYDROLOGY

The Red Rim petition area is within the Separation Creek drainage of the Great Divide Basin. About 10 percent of the petition area drains southwest into Fillmore Creek, a tributary of Separation Creek, about 1 percent drains directly into Separation Creek where it cuts through the rim, and the remaining 89 percent drains northeasterly to northwesterly into unnamed tributaries of Separation Creek. Separation Creek flows into Separation Lake, a playa sink about 15 miles north of Rawlins. All the streams in the petition area are ephemeral except Separation Creek itself, which is intermittent.

The estimated mean annual discharge from Separation Creek at the USGS gaging station (drainage area = 55 square miles (mi^2)), is 1,700 acre-feet. The estimated 100-year flood is 2,600 cubic feet per second (ft^3/s). Owing to percolation to the alluvium and to evapotranspiration, flows tend to decrease downstream. Thus, flows are often larger, per square mile, for the smaller, upland tributaries near the proposed mining area. For a 2-mi^2 upland stream, the estimated mean annual discharge would be about 170 acre-feet. The estimated 100-year flood would be about 900 ft^3/s (H. Lowham, U.S. Geological Survey, Cheyenne, Wyoming, oral communication, 1983).

There are three sources of ground water in the petition area: the Lance Formation, the Fort Union Formation, and the alluvium. A fourth potential source, the Mesaverde Formation, underlies the petition area but, because of its steep dip (about 30°) and depth, it is not tapped in the area.

The sandstone beds of the Lance Formation yield water to wells of sufficient quantity and quality for livestock use. At present, yields and transmissivities for parts of the Lance Formation are not known.

The Fort Union Formation is the principle aquifer in the general vicinity of the petition area. The formation consists of discontinuous lenses of sandstone, siltstone, shale, and coal. A sandstone more than 500 feet thick forms the base of the formation, yields for which range from less than 1 to as much as 325 gallons per minute (gal/min). The formation's highest yield well is a deep well (3,755 feet) penetrating the entire formation; most of the water from this well is probably from the basal sandstone. Transmissivities in the lenticular sections of the formation range from 0.5 to 52 cubic feet per day (ft^3/d) per foot of thickness. Transmissivity in the deep well was measured at 820 ft^3/d per foot of thickness (Larson and Zimmerman, 1981).

The alluvium along Separation Creek is an aquifer that readily yields water to wells. Elsewhere within the petition area, the alluvium is probably dry.

Recharge to the basal sandstone occurs along its outcrop, principally along Red Rim. Ground water moves generally northwest toward the Separation Creek and Fillmore Creek alluvium. The discharge is to streamflow and through evapotranspiration.

Separation Creek characterizes surface-water quality in the petition area. Samples from this creek vary in quality from about 100 to 2,000 milligrams per liter (mg/L) of total dissolved solids (TDS). The water quality tends to decrease downstream. Separation Creek water is a calcium, magnesium, sodium bicarbonate type in its headwaters, changing to a magnesium sulfate type in its lower reaches. Suspended sediment concentrations in the creek vary from less that 100 to 27,800 mg/L (Larson and Zimmerman, 1981).

Ground-water samples from the Fort Union Formation vary in quality from about 500 to 3,000 mg/L of TDS. One sample from the Lewis Shale had 57,700 mg/L TDS and one from the alluvium had 10,300 mg/L TDS. Ground water in the Fort Union Formation is a calcium bicarbonate type; in the Lewis Shale and the alluvium, it varies from a calcium bicarbonate to a magnesium sulfate type (Larson and Zimmerman, 1981).

A total of 73 wells have been permitted within 3 miles of the petition area. Eighteen of these are for stock watering, three for industrial use, two for the railroad, one each for domestic and commercial uses, and the remaining forty-eight for ground-water monitoring.

The water in the Red Rim petition area is generally satisfactory for wildlife and livestock but unsatisfactory for domestic use.

L. CULTURAL RESOURCES

A single large-scale cultural resource inventory has been conducted within the bounds of the Red Rim petition area. This inventory, which was contracted by BLM to be included in its Sweetwater-Kemmerer and Hanna-Atlantic Rim coal EIS, was completed in 1976 by Western Wyoming College. It covered approximately 50 percent of the Red Rim tract (Metcalf, 1977) or some 10,850 acres of land overlying coal seams identified by RME. Prior to the inventory, little was known about the specific cultural history of the Red Rim area. Although Western Wyoming College did not clarify its survey methods in the inventory documentation, college personnel apparently surveyed the 10,850 acres on foot, covering the ground with individuals spaced 100 to 150 feet apart. Based on current professional standards, a survey conducted in this manner would meet the criteria of a Class II intensity level survey. Twenty-seven sites were located by the survey; all of them were prehistoric and included, among other site types, open camps, lithic scatters, stone circle sites, and isolated hearths. Of the 27 sites, 20 were recommended as warranting further evaluation of their cultural significance. Most of the sites date from later prehistoric periods. However, some recovered artifacts suggest that the sites where they were found were occupied from at least the archaic period. Moreover, based on evidence from nearby sites (Allen Garette site 48 CR301, the Scoggins site, and the U.P. Mammoth site), it is likely that sites dating from the paleoindian through the protohistoric period may be found on the Red Rim tract. No historic sites were reported for the Red Rim tract by the Western Wyoming College survey (Metcalf, 1977).

At present, State of Wyoming archeological site files indicate that 21 sites in addition to those located by Western Wyoming College have been recorded within the bounds of the Red Rim petition area. These additional sites were located primarily as a result of a survey conducted in conjunction with energy development (that is, in the course of planning and building pipelines, drilling for oil and gas, uranium exploration, etc.); they are similar in type to those located by Western Wyoming College and, in some instances, occur within the 10,850 acres surveyed by the college.

Western Wyoming College found site densities for the 10,850 acres to range from one per section surveyed to an estimated twelve per section (projected based on site-density data from sections partially surveyed). The average density of sites actually located by their survey over the entire tract is approximately 1.5 sites per section. Most of the sections surveyed by the college are located in the northern two-thirds of the tract and west of the upland areas of the rim. A large part of the tract, ecologically more diverse than are the surveyed sections, has not been inventoried.

Both BLM (Mike Bies, BLM archeologist, Rawlins District, oral communication, March 1983) and Wyoming DEQ (Greg Smith, archeologist, oral communication, March 1983) believe that the site densities for the Red Rim petition area should be much higher than those reported by the Western Wyoming College survey (Metcalf, 1977). They base this belief on other recent surveys of the nearby region. In addition, BLM believes that there is considerable potential for finding older sites than those already found at Red Rim because its relict landscape has likely been preserved.

The areas surrounding Red Rim, particularly to the south and east, have a rich history. The Overland and Cherokee Trails run near the tract, Fort Steele is located directly east of Rawlins, and the White River Agency, site of the 1879 Ute Indian uprising, lies well to the south of the tract. A number of historic sites, in addition to the trails and Fort Steele, occur in these areas and include Fort Halleck and Washakie Station. The Rawlins to White River road (Baggs Road) just east of the petition area is currently being evaluated to determine its historical significance.

The current BLM lease stipulations (appendix J) require that an intensive cultural-resource field inventory be performed on the Red Rim tract prior to surface disturbance. All sites currently located, or located in the future, must be evaluated for their cultural and historical significance. For sites found eligible for nomination to the National Register of Historic Places, measures must be developed to mitigate any potential impacts to them from mining (National Historic Preservation Act of 1966, as amended; 1974).

M. NOISE

The existing noise level in the Red Rim tract resulting from natural causes is approximately 20 decibels (Bureau of Land Management, 1981b). Noise generated from the rail traffic on the north end of the tract has an equivalent continuous sound (L_{eq}) level of approximately 76 decibels (at 100 feet) along the rail lines (Bureau of Land Management, 1980). The nearest occupied dwelling that could be affected by noise from a mining operation is the Daley Ranch. It is approximately 1 mile from the proposed coal lease tract boundary and 1.5 miles from the nearest coal seam that would be mined. Persons pursuing recreational activities near the mine could also be affected by noise.

CHAPTER III

EVALUATION OF COAL RESOURCES AND SUPPLY OF AND DEMAND FOR COAL

Section 522(d) of SMCRA requires that, prior to designating any land areas as unsuitable for surface coal mining operations, the regulatory authority prepare detailed statements on (1) the potential coal resources of the petition area, (2) the demand for those coal resources, and (3) the impact, on the environment, economy, and coal supply, of designating the petition area as unsuitable for surface coal mining operations. This chapter presents a detailed evaluation of potential coal resources within the Red Rim petition area and of the demand for those resources; it also details the probable impacts on the economy and coal supply of designating the petition area unsuitable for surface coal mining operations. The probable impacts of such a designation on the environment are discussed in chapter IV.

A. COAL RESOURCES

The coal-geology and coal-resource discussions in this chapter are abstracted from Stiles and Pitman (1983). The coal seams for the Red Rim area are delineated on plate 1, as are the petition-area and coal-lease-tract boundaries. A railroad right-of-way in the northern part of the Red Rim area is included within the petition-area boundary but not within the proposed coal-lease-tract boundary (plate 1). Because of this, coal seams in T. 21 N., R. 89 W., SE¼SE¼ sec. 23, NW¼SW¼ sec. 24, and NW¼NE¼ and SE¼NW¼ sec. 26 (part of the railroad right-of-way) fall within the petition area but not within the proposed coal lease tract.

BLM has authority to designate no surface occupancy areas on Federal lands only. As part of its land-use planning process for the Red Rim area, BLM provided that, should Federal lands in the area be mined, "no surface occupancy areas" would be established to serve as buffer zones for the protection of golden eagle nests, as a riparian zone on either side of Separation Creek (plate 1), and as a migration corridor and an intact unit of critical winter habitat for pronghorn within the Red Rim tract. (See 46 F.R. 63402, December 31, 1981.) In a memorandum dated October 6, 1981, BLM described this pronghorn no surface occupancy area as those Federal lands that lie from any points 500 feet southeast of the easternmost mineable coal seam to the eastern tract boundary (appendix J). In a memorandum dated May 21, 1982, to better define the boundary of the area, BLM's Wyoming State Director proposed a legal description for it based on 40-acre alliquots. The two memoranda describe approximately, but not exactly, the same area. The impacts to Red Rim's recoverable coal resources of adopting each of these areas were analyzed in the draft PED/EIS. Since publication of the draft PED/EIS, BLM has again described its proposed pronghorn no surface occupancy area. The area as currently described is generally, but not exactly, the same as the October 6, 1981, and the May 21, 1982, pronghorn no surface occupancy areas addressed in the draft PED/EIS. The most recently described area is shown on plate 1. Table III-1 gives BLM's estimate of the Federal and private (RME) mineable coal resource at Red Rim should the current pronghorn no surface occupancy area, as well as the golden eagle nest buffer zones and the Separation Creek riparian zone no surface occupancy areas, be adopted as proposed (Stiles and Pitman, 1983; Marsha Kramer, BLM Rawlins District Office, oral communication, May 10,1985). The H bed would be precluded from mining by adoption of the current no surface occupancy area.

Table III-1.--BLM estimates of the in-place and recoverable coal resources of the Red Rim unsuitability petition area, assuming BLM's current pronghorn, Separation Creek riparian zone, and golden eagle nest buffer zones no surface occupancy areas are adopted on Federal lands as proposed

(Sources: Stiles and Pitman, 1983; Marsha Kramer, BLM Rawlins District Office, oral communication, May 10, 1985. BLM calculated coal resources within the petition area based on the following assumptions, which are consistent with those used by the Casper District Mining Supervisor to delineate the Red Rim tract for surface coal mining for the 1984 Green River-Hams Fork coal-lease sale: (1) the coal resource tonnage is measured in short tons; (2) the minimum thickness of the coal seam to be mined is 4 feet; (3) the maximum mining depth is 150 feet or a 10:1 stripping ratio, whichever is reached first; (4) the coal recovery factor is 87 percent, based on the recovery rate in the Hanna Basin; (5) the coal density is 1,750 tons/acre-foot; and (6), given these five assumptions, the in-place and mineable coal resource are synonymous)

Coal ownership	In-place resource (short tons)	Recoverable resource (short tons)	Surface acreage[1]
Within the petition boundary:			
Federal	48,721,316	42,387,545	2,172
Rocky Mountain Energy Company	34,527,691	30,039,091	2,089
Total	83,249,007	72,426,636	4,261
Pronghorn no surface occupancy area:			
Federal	274,762	239,043	30
Rocky Mountain Energy Company	67,536	58,756	7
Total	342,298	297,779	37
Separation Creek riparian zone and golden eagle nest buffer zones no surface occupancy areas:			
Federal	2,444,248	2,126,496	97
Rocky Mountain Energy Company	1,194,875	1,039,541	97
Total	3,639,123	3,166,037	194
Unaffected petitioned coal:			
Federal	46,002,307	40,022,006	2,044
Rocky Mountain Energy Company	33,265,278	28,940,793	1,985
Total	79,267,585	68,962,799	4,029

[1] Stiles and Pitman (1983) and Marsha Kramer (BLM Rawlins District Office, oral communication, May 10, 1985) estimate of non-adjudicated acreages for areas which directly overlie the coal seams.

1. Stratigraphy

The rocks exposed in the Red Rim area belong predominantly to the lower part of the Fort Union Formation, which dates from the Paleocene Age. The Fort Union Formation overlies the Lance Formation, which dates from the Upper Cretaceous Age, and is overlain by the Wasatch Formation, which dates from the Eocene Age. The Fort Union is a continental deposit and consists mostly of fluvial sequences of channel-filling sandstone, shaly claystone-mudstone, and swamp deposits of coal and carbonaceous shale.

The lower half of the Fort Union Formation is about 1,900 feet thick and consists of two unequal units: a basal sandstone unit and an upper, much thicker coal-bearing unit. Overlying the basal sandstone unit is the upper half of the formation, which is about 1,300 feet and consists of interbedded gray to grayish-brown mudstone and clay-shale, light-brown to yellowish-orange clayey siltstone, light-gray fine-to medium-grained sandstone, and coal. The coal beds in this 1,300-foot unit constitute the lower coal zone of the Fort Union and include the beds that would be mined at Red Rim.

2. Structure

Most of the Red Rim beds strike north-northeast. Surface dips range from 6° to 24° and are generally flatter to the northwest and steeper to the southeast. Dips determined from subsurface data in the area are generally not more than 5° (Barclay and Blanchard, 1981). Dips in the Fort Union steepen considerably near the crest of an anticline to the south of the area and on the north-northeast limb of a syncline to the north of the area (Barclay and Blanchard, 1981). RME has placed a fault trending northwest to southeast in T. 19 N., R. 90 W., secs. 5 and 8; however, very little displacement along this fault is indicated.

3. Coal Geology

The Red Rim area is in the northern part of the Little Snake River Known Recoverable Coal Resource Area (KRCRA), which extends along the east side of the Great Divide and Washakie Basins from near Rawlins to Baggs, Wyoming.

Several of the Upper Cretaceous-Paleocene geologic units underlying the KRCRA contain potentially valuable coal deposits. These units are the Allen Ridge, Almond, Lewis, Fox Hills, and Lance Formations, which date from the Upper Cretaceous Age, and the Fort Union Formation (Barclay and Blanchard, 1981). In the Red Rim area, only the coal-bearing unit in the lower half of the Fort Union is exposed. Coal beds in the upper half of the Fort Union crop out about 7 miles northwest of the Red Rim area around the Cherokee mines south of Creston Junction (Barclay and Blanchard, 1981). In the Red Rim area, coals of the other formations are at depths of about 4,000 feet or more (Barclay and Blanchard, 1981).

Coal beds are abundant in the Fort Union Formation and range from 1 to 38 feet in thickness. The coal beds in the northern part of the KRCRA and in the Red Rim area belong to the coal-bearing unit in the lower half of the Fort Union. Twelve beds in the Red Rim area are economically significant owing to their location, depth, thickness, and quality. These beds range in thickness from 2 to 38 feet, and contain subbituminous C to subbituminous B coal. The quality of coal in the beds generally increases toward the northeastern part of the Red Rim. Table III-2 shows Stiles and Pitman's (1983) quality analyses for the coal beds.

According to RME nomenclature, the economically mineable coal beds, in ascending order, are: H, G, Pine, F, R_3, E, R_2, R_1, D, C, B_2, and B_1.

H bed.--The H coal bed is in the northern part of the Red Rim area. It is the easternmost coal bed in the area, is of limited areal extent, and ranges in thickness from 4 to 6 feet, averaging 4.8 feet thick.

G bed.--The G coal bed is about 55 feet above the H coal bed. It lies in the northern and southern portions of the Red Rim area and is nonexistent in the central portion. The G bed ranges in thickness from 2 to 22 feet, averaging 12 feet thick; it has a lower and upper split which coalesce into the G bed.

Pine bed.--The Pine bed lies about 107 feet above the G bed and is of local areal extent in the northern part of Red Rim. The Pine bed ranges in thickness from 9 to 11.2 feet, averaging 10.1 feet thick. (The abandoned Pine Bed coal surface mine is located atop this coal bed in T. 21 N., R. 89 W., sec. 26. (See plate 1.) Approximately 60,000 tons of coal were removed from this mine between 1932 and 1941.)

F bed.--The F bed is 75.5 feet above the Pine bed and is the most continuous coal bed in the Red Rim area, although it thins to less than 4 feet for about 2,000 feet in T. 20 N., R. 89 W., sec. 7. The F bed ranges in thickness from 3 to 27 feet, averaging 15 feet thick; it has a lower and upper split in the southern part of the Red Rim area but occurs as one unit throughout the rest of the area.

R_3 bed (rider).--The R_3 bed is about 66 feet below the E bed and is of local areal extent in the northern part of the Red Rim area. The R_3 bed ranges in thickness from 4 to 11 feet, averaging 7.5 feet thick.

E bed.--The E bed is approximately 66 feet above the R_3 bed in the northern part of the Red Rim area and approximately 279 feet above the F bed in the remainder of the area. The E bed ranges in thickness from 2 to 16 feet, averaging 9 feet thick.

R_2 bed (rider).--The R_2 bed is very discontinuous and lies 126.5 feet above the E bed; it ranges in thickness from 5 to 9 feet, averaging 7 feet thick.

R_1 bed (rider).--The R_1 bed is also very discontinuous and is about 45 feet above the R_2 bed; it ranges in thickness from 5 to 12 feet, averaging 8.5 feet thick.

D bed.--The D bed is a fairly continuous coal bed from the north-central part to the southern boundary of the Red Rim area. It is about 123 feet above the R_1 bed and ranges in thickness from 4 to 7 feet, averaging 5.5 feet thick.

C bed.--The C bed occurs only in the southern part of the Red Rim area and is approximately 113 feet above the D bed; it ranges in thickness from 4 to 8 feet, averaging 6 feet thick.

B_2 bed.--The B_2 bed is approximately 222 feet above the D bed and ranges in thickness from 4 to 6 feet, averaging 5 feet thick.

Table III-2.--Average coal-quality data

(Data are computed by Stiles and Pitman (1983) based on data contained in D. H. Emling Company (1978). Data are on an as-received, average proximate basis)

Bed	Tons of coal[1]	Number of samples	Btu/lb	Percentage moisture	Percentage ash	Percentage sulfur
B_1	12,390,847	13	8,356	26.30	7.80	0.50
B_2	1,769,773	4	8,448	27.10	6.20	0.40
C	7,331,603	5	7,745	24.90	12.20	1.19
D	5,660,485	12	8,482	26.70	5.40	0.40
R_1	1,155,999	1	9,362	21.00	5.80	0.52
R_2	1,251,603	1	9,504	19.80	5.10	0.34
E	10,926,359	15	8,168	23.60	11.40	0.60
R_3	913,339	1	9,646	17.80	7.60	0.48
F	27,825,967	33	8,453	23.92	9.00	0.30
Pine	3,673,656	6	9,562	17.68	6.73	0.30
G	10,007,074	16	9,085	20.94	7.09	0.36
H(2)	342,298	---	---	---	---	---

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[1] In-place tonnage estimates are included here to show the relative amounts of coal in the twelve coal seams.

[2] No proximate-analysis data available.

B_1 bed.--The B_1 bed is approximately 38 feet above the B_2 bed; it ranges in thickness from 4.5 to 18 feet, averaging 11.3 feet thick. The B_1 bed is split into the B_1 Lower and the B_1 Upper beds but, for purposes of this report, is considered one bed.

B. THE SUPPLY OF AND DEMAND FOR PETITION-AREA COAL

1. National Supply of and Demand for Coal

The demand for coal in the United States has increased fairly steadily since the Oil Embargo of 1973. Coal is expected to remain an important source of energy for years to come. Table III-3 gives DOE (1985) projections for national coal consumption, by users, through 1995.

The actual future demand for domestic coal will be affected by numerous factors, one of the more important of which factors is the extent to which the synthetic fuels industry is developed in the United States. Other factors affecting future demand include the price of alternative energy sources, such as oil and natural gas, the development of alternative energy sources, the number of coal-fired electric powerplants, the expansion of foreign markets, and the availability of transportation systems.

The consumption of coal within the United States should not be affected by supply constraints in the foreseeable future. OTA estimates that, as of 1981, less than 20 percent of the total coal reserves owned by the Federal government were under lease (Office of Technology Assessment, 1981). National coal production has increased 46 percent since 1973, when 598 million tons were produced. National production in 1984 was 871 million tons (U.S. Department of Energy, 1985), and production is expected to increase steadily for the next few decades. In 1980, DOE estimated that the coal industry was operating at only 87.9 percent of its capacity (U.S. Department of Energy, 1980).

2. Regional Supply of and Demand for Coal

The State of Wyoming is rich in energy resources, including substantial deposits and reserves of oil, natural gas, and coal. In 1984, Wyoming produced 128 million short tons of coal, or about 14.7 percent of the coal produced nationwide (871 million short tons of coal; U.S. Department of Energy, 1985). BLM estimated Wyoming's 1984 capacity for coal production to be 142 million tons per year (Bureau of Land Management, 1985). Wyoming's coal output has more than doubled since 1977; its demonstrated reserve of 55,371.9 million short tons of coal should make it a major energy producer for the United States in the foreseeable future (Bureau of Land Management, 1980). The majority of Wyoming's coal is used to generate electricity. If developed, a synthetic fuels industry could provide a new source of demand for Wyoming coal.

According to the Wyoming Department of Economic Planning and Development, coal production in Carbon County will continue to decline through 1987. In 1980, 9.7 million tons of coal were produced in the county; in 1984, 3.45 million tons were produced. In 1988, 1.45 million tons are projected to be mined. Despite these trends, OTA estimates that, by 1990, demand for southern Wyoming coal will be between 42 and 51 million tons per year. The capacity for production from all Federal mines, including those not yet permitted and those anticipated on

Table III-3.--Coal consumption by end-use sector

(Source: U.S. Department of Energy, 1985)

	Consumption (millions of tons)			
	1984 (actual)	1985	1990	1995
Domestic consumption:				
Electric utility	664	702	805	951
Industrial	73	77	95	104
Residential and commercial	9	83	7	7
Domestic coking	44	42	51	49
Total domestic consumption:	790	904	958	1,111
Net exports	81	74	91	106
Total production:	871	978	1,049	1,217

READEX FICHE

currently undeveloped leases in the southern Wyoming coal fields, is projected to reach 48 million tons per year by 1991 (Office of Technology Assessment, 1981). In 1985, a Federal competitive coal-lease sale is anticipated for the Green River-Hamms Fork region, which includes southern Wyoming and northwest Colorado. If leased, these tracts, together with those incorporating existing and proposed mines, would produce approximately 83 million tons per year of coal by 1995 (Bureau of Land Management, 1983).

3. Supply of and Demand for Petition-Area Coal

Using a coal-transportation model developed by Bernkopf and Gordon (1980) for USGS, OSM performed an economic analysis that compared coal from the Red Rim petition area with other coals available to meet national coal demand in the year 1995 (Bernkopf and Gordon, 1980). The model is a linear programming model which allocates coal produced nationally in mining districts by mining method and coal quality to consuming centers; it selects an "optimal solution" that minimizes the total delivered cost of meeting given coal demands, expressed in Btu's per year, in 1995. The model assumes 99 supply regions, 243 demand regions, and four modes of transportation (regulated rail, barge, unit train, and high-voltage transmission); its solution to the demand problem considers projected mining costs, transportation costs, and the costs of environmental-protection measures associated with burning coal. The model operates in constant 1978 dollars, thereby eliminating future inflationary effects from the results. The basic model was run twice for the Red Rim petition area to reflect two potential shipping patterns: (1) unrestricted shipping in any direction and (2) coal delivery only outside the local area (that is, east of Wyoming, Colorado, Montana, and New Mexico). The second run was made to test the strength of demand for the coal outside the local consuming region.

Information on the coal resources both of Wyoming and of the petition area was obtained from BLM (Bureau of Land Management, 1980; Stiles and Pitman, 1983). For the two Red Rim petition area runs, the coal transportation model assumed that:

- Red Rim coal yielded 8,560 Btu's per pound, contained 0.45 percent sulfur, and cost $6.79 per ton (1995 price) at the minesite (free-on-board (FOB) mine price), expressed in 1978 constant dollars.
- The delivered price of coal from the petition area included transportation costs and scrubbing costs (table III-4) to meet EPA emission standards (the model computed the coal transportation and scrubbing costs and then added these costs to the FOB mine price to arrive at a delivered price for the coal).
- The petition area was being mined according to DOE's medium demand scenario for coal for 1995.

According to coal-transportation-model results, the Red Rim petition area would produce 2.5 million tons of coal annually under an unlimited leasing scenario. Under the assumptions of run number one (unrestricted shipping), the model found that Red Rim coal would be consumed primarily by the local market. Specifically, southeastern Idaho (Pocatello area) would consume 5 percent of Red Rim's coal, northern Utah (Salt Lake City area) would consume 11 percent, and southern Wyoming (Rock Springs area) would consume 84 percent. The Red Rim coal would

Table III-4.--Coal shipment and costs from the Red Rim petition area under an unlimited leasing scenario, 1995[1]

(Source: Bernkopf and Gordon, 1980. Values are in constant 1978 dollars)

Parameter	Consuming regions[2]				
	Unrestricted shipping[3]			Restricted shipping[4]	
	Idaho	Utah	Wyoming	Nebraska	Texas
Total coal shipped (thousand tons)[5]	123	279	2,088	900	1,600
Mine mouth cost (dollars/ton)	$6.79	$6.79	$6.79	$6.79	(6)$8.15
Transportation cost (dollars/ton)	7.70	4.45	0.80	10.72	7.07
Scrubbing cost (dollars/ton)[7]	0	0	0	0	9.80
Total delivered cost (dollars/ton)	14.49	11.24	7.59	17.51	25.02

[1] Values in this table reflect new coal shipments from the petition area to the consuming regions. Values in this table represent only a partial listing of the coal-transportation model's results.

[2] Consuming regions are defined by the coal-transportation model and represent only a relative size and direction of the coal shipments. Actual shipments would probably vary.

[3] Results are from run number one of the model.

[4] Results are from run number two of the model.

[5] Coal shipments from the petition area were assumed to be limited to approximately 2.5 million tons annually.

[6] FOB mine prices differ, because the coal-transportation model escalated new demand at a higher rate than it escalated old demand (1.5 vs. 1.25). This reflects competition from long-term coal contracts at older facilities.

[7] Scrubbing costs reflect EPA standards and are based on the PEDCO (1979) model. There is no scrubbing cost for coal burned in old coal-fired powerplants.

replace coal from those mining companies currently supplying powerplants in Idaho, Utah, and Wyoming. Under the assumptions of run number two (coal delivery only outside the local area), the model found that 36 percent of Red Rim coal would be consumed by western Nebraska (Grand Island area) and 64 percent by northern Texas (Amarillo area). The coal shipped to Texas would be scrubbed in order to meet EPA standards for a new powerplant.

Should the Red Rim area be designated as unsuitable for surface coal mining operations, the national supply of coal would not be affected overall. It is likely that coal from Red Rim would be replaced by comparably priced coal from other mines in the region. In addition, should such a replacement occur, it is likely that coal prices would not be discernably affected.

CHAPTER IV

ANALYSES OF PETITION ALLEGATIONS AND IMPACTS

The Red Rim unsuitability petition contains two primary allegations: (1) surface coal mining operations in the Red Rim petition area would adversely affect fragile land that is valuable habitat for pronghorn and (2) reclamation of this land in accordance with SMCRA is not technologically and economically feasible. This chapter contains OSM's responses to each of these primary allegations as well as to certain secondary allegations in support of them. (See sections IVB and IVC.)

Because the proposed Red Rim coal lease tract has not yet been leased, no site-specific mining plan for the Red Rim area, which any lessee proposing to mine it would be required to develop, yet exists. For this reason, in order to concretely evaluate the petition's allegations regarding prospective surface coal mining operations at Red Rim, OSM developed certain assumptions regarding how mining and reclamation would occur there. These assumptions are set forth in section IVA. Section IVA also describes the three reclamation scenarios OSM developed to encompass the full range of possible approaches to reclamation of the Red Rim area. Should the Secretary of the Interior decide (1) not to designate any of the petition area as unsuitable for surface coal mining operations or (2) to designate only parts of the area as unsuitable for such operations, he could, upon receipt of a permit application for Red Rim, approve a mining plan and issue a permit to mine all or part of the petition area. So doing, he could require that the area be reclaimed, to a multiple-use native grassland for livestock grazing, wildlife habitat, and recreation (BLM's current classification of the petition area), in accordance with any one of these three reclamation scenarios or with any other reclamation plan deemed appropriate to mitigate the effects of surface coal mining operations on the Red Rim pronghorn critical winter range. Chapter V analyzes the probable impacts of the Secretary adopting decision alternatives that would allow mining on all or part of the petition area (alternatives B1, B2, B3, C1a, C1b, and C1c) in the context of reclamation which might occur under these three reclamation scenarios. The probable impacts of implementing each of these three scenarios are compared for certain of the petition allegations in section IVB and IVC.

A. ASSUMPTIONS

The analyses presented and conclusions drawn in this chapter constitute the best professional estimates of OSM staff regarding the effects of mining and reclamation on the environment of Red Rim. Because Red Rim has not yet been leased, no detailed environmental baseline studies, which the successful Federal coal lessee would be required to develop, yet exist. Therefore, even these best professional estimates are subject to proof by site-specific data once these are available.

In the absence of a site-specific mining plan for the petition area, the evaluation of the petition allegations in this chapter is based on (1) a "Maximum Economic Recovery and Mining Methods" report, developed by USGS in 1978 (U.S. Geological Survey, 1978), (2) a 1983 BLM coal-resource report developed by that agency specifically for this petition analysis (Stiles and Pitman, 1983), (3) a 1981 BLM tract profile and site-specific analysis document for the proposed Red Rim tract (Bureau of Land Management, 1981b), and (4) a 1978 preliminary mining plan describing how the Red Rim tract would be mined (D. H. Emling Company, 1978). The three USGS and BLM reports were based in part upon information supplied by RME, which, together with Energy Development Company, developed the preliminary mining plan. OSM also considered the information contained in Taylor Lawrence's and RME's intervention petitions; all oral and written comments received from the petitioners, intervenors, and the public at the public hearing; other written comments on the petition and draft PED/EIS received during the comment period; and information regarding the progress of mining and reclamation at active coal mines in southcentral Wyoming.

OSM assumes that the 12 coal seams on the proposed Red Rim leasehold would produce about 2 million tons of coal per year for 30 to 35 years. Coal would be extracted by surface mining methods, probably by dragline, although a truck-and-shovel operation is also feasible. The maximum stripping depth would be 150 feet or the depth at which a 10:1 overburden:coal stripping ratio is reached, whichever is less (Stiles and Pitman, 1983).

Mining would disturb roughly equal proportions of the Federal and private lands distributed in a checkerboard over the petition area. Mining disturbances, including pits, spoil areas, and road for the dragline(s) to walk between pits on different coal seams, would total a maximum of about 11,000 acres (estimate based on D. H. Emling Company (1978) mine-disturbance maps). This acreage estimate includes narrow strips and islands of unmined land that would be inaccessible or unavailable to pronghorn. About 900 to 1,000 additional acres of petition area Federal and private lands would be disturbed for haul roads, topsoil storage areas, and onsite surface mine facilities (Bureau of Land Management, 1981b). During the life of the mine, a maximum of approximately 4,900 acres of mined land would be unreclaimed at one time. Table IV-1 shows the assumed annual surface disturbance and cumulative unreclaimed surface disturbance of a mine on the Red Rim tract. A railroad spur would be used to transport the coal northward from the tract to the main east-west railroad line.

The preliminary mining plan (D. H. Emling Company, 1978) upon which OSM has based its estimates proposed strikeline mining with a dragline. However, dipline mining with a dragline or dipline mining with truck and shovel could create less mine disturbance than strikeline mining with a dragline. RME has estimated that truck-and-shovel mining could reduce the surface disturbance of strikeline mining with a dragline by as much as 30 percent (Paul R. Widinski, Manager, Mine Operations, Rocky Mountain Energy Company, oral communication, January 23, 1985). However, for the purposes of this PED/EIS, the impact analyses are based on the mining method proposed in the preliminary mining plan (D. H. Emling Company, 1978), because this constitutes the maximum-impact mining scenario.

BLM's current mitigation requirements, to be appended as stipulations to any lease issued for the proposed Red Rim coal lease tract, include provisions to mitigate pronghorn habitat loss (appendix J, mitigation requirement 11). These provisions would require the successful lessee, in consultation with the State of Wyoming, to develop a habitat recovery and replacement plan. This plan, which may be implemented in areas both on and off the leasehold, must include (1) an analysis of pronghorn habitat within the lease area (which would identify significant pronghorn populations and important topographic features and analyze vegetation) and (2) a proposal regarding how the lessee would mitigate impacts to that habitat (which may include proposals to increase the quantity and quality of

Table IV-1.--Annual surface disturbances and cumulative unreclaimed surface disturbances of a mine on the Red Rim tract

(The annual disturbance acreages are calculated based on RME's preliminary mining plan (D. H. Emling Company, 1978). The cumulative disturbance acreages assume 12 years for reclamation. (See sections IVB and IVC and appendix F for a discussion of this assumption.))

Year	Annual disturbance (acres)	Cumulative disturbance (acres)
1	215.4	215.4
2	302.7	518.1
3	85.9	604.1
4	86.0	690.2
5	1,074.1	1,764.3
6	278.0	2,042.3
7	64.6	2,107.0
8	209.1	2,316.1
9	44.8	2,360.9
10	574.0	2,934.9
11	432.3	3,367.2
12	427.0	3,794.3
13	189.5	3,768.4
14	236.5	3,702.3
15	396.5	4,012.8
16	683.0	4,609.8
17	340.4	3,876.1
18	383.3	3,981.4
19	377.3	4,292.2
20	285.4	4,370.4
21	573.6	[1]4,899.3
22	560.2	4,885.5
23	264.4	4,717.7
24	345.1	4,635.8
25	133.5	4,579.8
26	178.3	4,521.5
27	358.6	4,483.7
28	677.3	4,477.9
29	396.0	4,533.5
30	280.9	4,431.1
31	538.8	4,592.5
32	0	4,307.1
33	0	3,733.5
34	0	3,173.2
35	0	2,908.7
36	0	2,563.6
37	0	2,430.0
38	0	2,251.7
39	0	1,893.0
40	0	1,215.7
41	0	819.7
42	0	538.8

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[1] Maximum unreclaimed surface disturbance.

forage at Red Rim, to mitigate other related offsite conflicts, to acquire critical wildlife habitat, and to mechanically manipulate habitat to alter successional stage). At this preleasing stage, the details of a prospective successful lessee's habitat recovery and replacement plan are, of course, unknown. Although OSM assumes a habitat recovery and replacement plan would be developed by the lessee, without the details of that plan, the impacts of implementing such a plan on the pronghorn using Red Rim cannot be predicted. In general, BLM's requirements for a habitat recovery and replacement plan for Red Rim (appendix K) would be that it assure reestablishment, in order of priority, of (1) broken topography features, (2) sufficient vegetative ground cover to stabilize disturbed land areas from erosion, and (3) ultimate vegetative ground cover and species composition to approach premining conditions. The purpose of these requirements would be to guarantee adequate reclamation of the Red Rim pronghorn critical winter range, consistent with Wyoming GFD's population-management objective for the Baggs Herd. The primary postmining land uses of the proposed coal lease tract would be livestock grazing, wildlife habitat, and recreation.

OSM assumes that the golden eagle nest buffer zones, Separation Creek riparian zone, and pronghorn no surface occupancy areas as currently proposed would not change prior to BLM putting the tract up for lease. (Plate 1 in the back of this volume of the PED/EIS shows the location of the proposed no surface occupancy areas.) BLM has refined its legal description of the pronghorn no surface occupancy area since publication of the draft PED/EIS. The pronghorn no surface occupancy area as currently described is generally, but not precisely, the same area as the October 6, 1981, and the May 21, 1982, pronghorn no surface occupancy areas addressed in the draft PED/EIS.

The potential impacts of surface coal mining operations at Red Rim are described in this chapter in terms of three reclamation scenarios. Under reclamation scenario 1, the goal of reclamation would be to reclaim all mined lands within the petition area, including the pronghorn critical winter range, to closely approach their premining condition and carrying capacity. In general, reclamation under this scenario would exceed the minimum requirements of current Wyoming DEQ regulations. However, it is conceivable that, owing to the importance of the pronghorn critical winter range on the tract, Wyoming DEQ and OSM could require the reclamation stipulations outlined in this scenario as conditions of permit approval or the Secretary of the Interior or BLM could stipulate them as conditions of the Federal lease. Under reclamation scenario 2, the goal of reclamation would be to reclaim all mined lands on half the petition area, including those on that part of the pronghorn critical winter range comprised by this half, to closely approach their premining condition and carrying capacity (in effect, to reclaim in accordance with reclamation scenario 1). Mined lands on the other half of the petition area, including those on that part of the pronghorn critical winter range comprised by this half, would be reclaimed in accordance with standard reclamation practices to a multiple-use native grassland for livestock grazing and wildlife habitat (in effect, reclaimed in accordance with reclamation scenario 3). This scenario was developed to take account of the Federal-private checkerboard land ownership pattern of the petition area: OSM and BLM could require a different level of reclamation for the Federal lands within this checkerboard from that required by Wyoming DEQ for private lands within it. Under scenario 3, the goal of reclamation would be to reclaim all mined lands within the petition area, including the pronghorn critical winter range, in accordance with Wyoming DEQ regulations and with standard practices currently used in Wyoming to a multiple-use native grassland for livestock grazing and wildlife habitat. Under this scenario, standard soil-hauling and planting techniques, as well as planting configurations, would be slightly modified to somewhat increase the suitability of the area for pronghorn.

In summary, the three reclamation scenarios are:

Reclamation scenario 1.--Under this scenario, the goal of reclamation would be to reclaim all mined lands within the petition area, including those on the pronghorn critical winter range, to closely approach their premining condition and carrying capacity. Reclamation under this scenario would require:

Topography.--The topography of the mined area would be returned to a condition closely resembling that of the existing landscape. Special care would be given to (1) reconstructing draws and ridges that provide shelter to pronghorn and blow clear of snow during winter storms, (2) recreating major drainages and narrow draws (important as shelter for pronghorn and for collection of moisture for shrubs) that had been mined, and (3) restoring disturbed slopes to aspects and gradients similar to those now on the area. (Note that many of the upper reaches of narrow draws in the petition area would be either outside the area assumed to be mined or within BLM's proposed pronghorn no surface occupancy area.) Windswept slopes would be reestablished where pronghorn congregate during the winter.

Vegetation.--The revegetation effort would focus on reestablishing four shrub types: Wyoming big sagebrush, big sagebrush (Wyoming and basin), fourwing saltbush and shadscale, and mountain shrub. Revegetation with Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*) and basin big sagebrush (*Artemisia tridentata* ssp. *tridentata*) would mitigate loss of pronghorn critical winter range by reestablishing optimum vegetation patterns for pronghorn herd maintenance on the reclaimed landscape. Wyoming big sagebrush would be planted on and near windswept areas where it would be available to pronghorn during severe winters. Shrubs would be planted in selected areas of greater effective moisture to serve as pronghorn forage and to provide additional shelter to pronghorn during winter storms. Postmining shrub density would be reduced somewhat from the premining density, but dominant species cover values would be similar to or would exceed premining values. Given the limited success of big-sagebrush revegetation efforts using direct seeding alone, the effort at Red Rim would use tubelings, transplants, and direct seeding. An attempt would be made to reduce grass and forb competition with the shrubs. (Note that revegetation under this scenario would also yield livestock forage, although that would not be its primary goal.)

Soils.--Because the success of reestablishing big sagebrush on this site would be highly dependent upon selective soil salvaging and replacement, an intensive survey, in conjunction with appropriate chemical and physical analyses, of petition-area soil would be necessary prior to mining. When mining first began, soil would be stockpiled. Thereafter, to promote successful sagebrush establishment and to take advantage of plant propagules in the soil, all salvaged soils to be used in sagebrush planting areas would be directly hauled and respread on spoil graded to the final postmining contour. Suitable soils from the big-sagebrush-dominated vegetation types generally would be removed in two lifts and directly respread in two layers on contoured spoil in those areas where big sagebrush was to be established. (See appendix F for a discussion on the necessity for a two-lift soil salvaging program.) Because it would be difficult for scrapers to remove just the thin topsoil layer in the area, the first lift would include both topsoil and some subsoil (the A horizon and part of the B horizon, if present). The second lift would include an adequate amount of unconsolidated subsoil material to ensure that the two lifts of material, when replaced, would provide a sufficient depth of suitable rooting material for successful shrub regeneration and maintenance. Owing to their limited depths, shallow and very shallow Entisols would not be removed in two lifts.

Reclamation scenario 2.--Under this scenario, the goal of reclamation would be to reclaim all mined lands on half the petition area, including those on that part of the pronghorn critical winter range comprised by this half, to closely approach their premining condition and carrying capacity (in effect, to reclaim in accordance with reclamation scenario 1). Mined lands on the other half of the petition area, including those on that part of the pronghorn critical winter range comprised by this half, would be reclaimed in accordance with standard reclamation practices to a multiple-use native grassland for livestock and wildlife habitat (in effect, reclaimed in accordance with reclamation scenario 3, a discussion of which follows).

Reclamation scenario 3.--Under this scenario, the goal of reclamation would be to reclaim all mined lands within the petition area, including those on the pronghorn critical winter range, in accordance with standard reclamation practices to a multiple-use native grassland for livestock grazing and wildlife habitat. Typically, multiple-use rangelands are revegetated by way of standard reclamation practices using native grass and shrub species. However, standard reclamation practices would have to be modified to facilitate revegetation of Red Rim under this reclamation scenario. Specifically, standard soil-handling and planting techniques, as well as planting configurations, would be slightly modified to somewhat increase the suitability of the area for pronghorn use. Reclamation under this scenario would require:

Topography.--The topography of the mined area would be returned to the approximate original contour condition required by Wyoming DEQ rules and regulations. Generally, the postmining topography would be less diverse than the existing topography; postmining hillslope gradients would be reduced from premining gradients. Hillslopes would be reconstructed to generally their current configuration, but drainage densities, local relief, and variabilities in aspect would be reduced. Suitable exposures and sheltered areas for pronghorn would exist on the reclaimed mine area, but at a lower than premining level. Postmining drainage density would be about 15 to 35 percent of the existing drainage density. Reclaimed stream channels would be much less steep-sided than are existing channels. Small depressions could be constructed to collect moisture for shrub plots.

Vegetation.--Standard reclamation practices would be slightly modified to facilitate revegetation of Red Rim under this scenario. The revegetation effort would focus or reestablishing forage for livestock, but an attempt would be made to modify standard planting techniques and configurations to somewhat increase the suitability of the area for pronghorn. Revegetation would be primarily seed-based. Most landowners of mined land in Wyoming have been agreeable to revegetation with seed mixes including shrub seeds such as four-wing saltbush. In addition to seeding, sagebrush islands would be planted, preferably in areas on or near topographic features useful to pronghorn to provide them limited postmining forage and habitat.

Soils.--The mine spoil would be graded to approximate original contour. In accordance with Wyoming DEQ regulations and guidelines, and with standard reclamation practices, soil would be selectively salvaged and replaced on this graded spoil. Only the most suitable soil and overburden materials would be used for those sites where sagebrush was to be reestablished. It would be necessary to haul the salvaged soil material directly to sagebrush planting areas.

For a more detailed description and analysis of how topography, vegetation, and soils would be affected by reclamation under the two basic reclamation scenarios (scenarios 1 and 3), see appendix F.

Impacts identified in sections IVB and IVC are categorized as short-term if they would occur only during the life of mining and reclamation (assumed to be about 40 to 45 years: 30 to 35 years for mining and reclamation operations and a minimum of 10 years for bond release after seeding, fertilizing, irrigation, or other work to ensure revegetation is completed) and as long-term if they would persist after mining and reclamation have been completed.

B. RESPONSES TO ALLEGATION 1

The major issue of allegation 1 is that "Surface coal mining operations will adversely affect fragile land which is valuable habitat for pronghorn antelope." The petition contains statements and secondary allegations in support of this allegation. Certain of these are quoted below, followed by OSM's analysis of them.

Page 3, paragraphs 1 and 2, state:

> "Pursuant to 30 U.S.C. 1272(a)(3)(B), 30 C.F.R. 762.11(b) (1981), and Wyo. Stat. Section 35-11-425(b)(ii)(B) (Supp. 1981) upon petition, the Wyoming Environmental Quality Council (EQC) may designate an area as unsuitable for certain types of surface coal mining operations of 'fragile lands'--if the operations could significantly damage important scientific or aesthetic values or natural systems.
>
> "Surface coal mining operations will have a detrimental impact on 'fragile lands'."

Page 4, paragraph 3, states:

> "Examples of "fragile lands" are provided in 30 C.F.R. 762.5 (1981) and Wyoming DEQ Land Quality Division Rules and Regulations Chapter XVIII, Section 1(2)(1981), and include 'valuable habitats for fish and wildlife.' Critical winter habitat for

> pronghorn is clearly valuable--indeed essential--habitat for wildlife. As such, Red Rim qualifies as statutory 'fragile lands,' to which the EQC may apply its authority."

30 CFR 762.5 defines fragile lands as "geographic areas containing natural, ecologic, scientific, or esthetic resources that could be damaged or destroyed by surface coal mining operations. Examples of fragile lands include valuable habitats for fish or wildlife * * *."

Pronghorn (Antilocapra americana) belong to the family Antilocapridae, which is indigenous to North America (Wildlife Management Institute, 1978). While pronghorn are present in several States, an average of over 50 percent of the North American population of pronghorn inhabit Wyoming (Sundstrom and others, 1973; Wildlife Management Institute, 1978). Wyoming GFD data indicate that the average nonresident pronghorn hunter spends approximately $368 for a license, food, transportation, and so forth, to hunt a single pronghorn; the average resident spends $117. Wyoming GFD estimates that, in 1983, $24.1 million were spent by pronghorn hunters in Wyoming. Since (1) pronghorn are indigenous to North America, (2) the majority of the North American pronghorn population inhabits Wyoming, and (3) pronghorn are valuable game in Wyoming, Wyoming's pronghorn population, including the Baggs Herd, which uses the Red Rim area, constitutes an important natural, scientific, and economic resource.

Pronghorn critical winter range is "valuable habitat" according to the definition of "fragile lands." (See section IIA for a definition of "critical winter range.") Such habitat is limited in extent and, because severe winters with deep snows are probably the greatest cause of natural pronghorn death, vital to the survival of animals dependent upon it (Yoakum, 1980). Surface coal mining on the Red Rim critical winter range would adversely impact pronghorn habitat and, by extension, the pronghorn dependent upon it. Surface mining operations would require construction of support facilities, the disturbance and reclamation of habitat sequentially, by parcels, and the influx and increased activity of people. The extent and intensity of adverse impact would depend on the type and amount of disturbance, when and where it took place, and its duration. These impacts are discussed later in this chapter under other allegations.

OSM therefore agrees that fragile lands exist within the petition area.

Page 4, paragraph 2, states:

> "Red Rim is a critical winter range for pronghorn."

Pages 4 and 5, paragraphs 4 and 1, state:

> "Traditionally between 1,200 and 2,800 pronghorn winter on Red Rim[2] because their essential needs (food and shelter) are provided there. Thus, the GFD, in conjunction with the Bureau of Land Management (BLM), has designated 15,200 acres of land on Red Rim, part federal and part non-federal, as 'critical wildlife habitat' for a significant portion of the Baggs pronghorn herd.[3]"

Page 6, paragraph 3, states:

> "The proposed Red Rim lease tract includes 10,160 acres of non-federal land, more than 75% of which has been designated by GFD as critical wildlife habitat."

Critical habitat is made up of particular components, such as food and cover, which are essential to some aspect of a pronghorn population's life requirements. Red Rim in particular contains vital forage and shelter that enable a portion of the Baggs Herd to survive the harsh winters common to this part of Wyoming.

The Wyoming GFD classification of Red Rim winter range as critical (i.e., as critical winter range) can be documented back to at least 1981. In a briefing report prepared for the Governor (Wyoming Game and Fish Department, 1981a), the Wyoming GFD explained how ongoing research (Irwin and others, 1981, 1982, and 1983) of the Red Rim pronghorn population documented annual movement to and concentration on the area as winter conditions intensified. The report also explained the topographic and vegetative characteristics of Red Rim that attract and support pronghorn through the winter.

Table II-3 shows the estimated winter populations of pronghorn associated with Red Rim since 1977. These are estimates made by professionals and researchers familiar with Red Rim and are based on aerial and ground surveys. The number of pronghorn using the critical winter range varies, depending on winter storms and the severity and duration of the winter. Available pronghorn population data for Red Rim indicate that winter populations have ranged from an estimated 689 pronghorn to an estimated 2,427 pronghorn. The average low estimate for the area is 860 pronghorn; the average high is 1,722. Based on its population estimate for the moderately severe 1978-79 winter, Wyoming GFD estimated that at least one-third of the Baggs Herd population-management objective (one-third of 7,200 or 2,400 pronghorn) depend on the Red Rim critical winter range (Bureau of Land Management, 1981a). Based on data from actual counts, a maximum of about 20 percent of the Baggs DAU was actually present on Red Rim at one time. (See 1978-79 estimate data in tables II-1 and II-3.)

The petitioners estimate the critical winter range to total 15,200 acres. OSM's estimate of the critical winter range is 16,870 acres (based on Wyoming Game and Fish Department (1983)) and 17,582 acres (based on Bureau of Land Management, written communication, February 7, 1983; see appendix I). Using the 17,582-acre estimate, approximately 71 percent (12,426 acres) of the critical winter range falls within the petition area; approximately 64 percent of the privately owned lands within the boundaries of the proposed lease tract (6,222.5 acres) fall within the pronghorn critical winter range. OSM's estimate of the total amount of all proposed lease tract lands, both Federal and private, falling within the critical winter range is also about 64 percent, since the tract is located in a checkerboard land ownership area and contains almost equal amounts of Federal (9,728.89 acres) and private (9.722.61 acres) lands. Although the petitioners' acreage and percentage estimates are high, the fact remains that a substantial portion (almost two-thirds) of the proposed lease tract is critical winter range.

Page 3, paragraph 2, alleges:

> "The operations could result in significant damage to valuable wildlife habitat, including critical winter range for pronghorn antelope."

Page 4, paragraph 2, alleges:

> "Surface coal mining operations on Red Rim would do significant damage to both this habitat and the pronghorn herd relying on it."

Page 6, paragraph 2, alleges:

> "Surface coal mining would clearly alter this unusual topographic-vegetative relationship, drastically reducing Red Rim's unique ability to meet the essential needs of wintering pronghorn."

Under normal conditions, wildlife exist in a dynamic equilibrium with their habitat. However, any time habitat is reduced or significantly altered, this equilibrium is upset and wildlife are forced to adjust accordingly. Wyoming GFD periodically sets a population-management objective for the Baggs Herd. (Wyoming GFD's 1985 population-management objective for the herd is 7,200 (Moody, 1983).) Prior to the initiation of mining, Wyoming GFD would probably reduce the population-management objective for the herd (Harry Harju, Wyoming Game and Fish Department, oral communication, 1983). If the herd exceeded this new objective, the herd would probably have to be reduced prior to mining. While this is not Wyoming GFD's preferred course of action, it would be necessary for proper herd management. If this reduction were not accomplished, pronghorn occupying the Red Rim area would be displaced to adjacent unmined habitat. This displacement would likely result in increased intraspecific competition for food and cover. Overcrowding could result, leading to degradation of range conditions and inadequate nutrition for pronghorn and, consequently, in increased winter mortality, increased susceptibility to disease, and reduced chances for pronghorn does to produce healthy young.

The reduction of critical winter range area is only one of the many mining-related impacts that would affect pronghorn in the Red Rim area. Table IV-2 lists other activities associated with coal mining that would adversely impact pronghorn over the short and long term. Some of these impacts, such as surveying and drilling, would be temporary, simply causing pronghorn to move until the disturbance is over. Potential barriers to pronghorn movement created by additional fences, spoil piles, facilities, and pits would result in short-term, potentially significant adverse impacts. Such impacts include loss of access to certain feeding areas, additional energy expended to go around pits, and increased potential for losses during severe storms if pronghorn are driven into fences. Fencing could be designed to permit pronghorn passage, but some hazards would still exist. There would be numerous, potentially significant, secondary impacts resulting from the influx and increased activity of people in the area. Such impacts include poaching, road kills, and harassment.

Mining and reclamation of Red Rim under any of the three reclamation scenarios would have adverse impacts on the critical winter range. Based on 1978 mining sequence maps prepared by D. H. Emling Company (1978), OSM estimates that approximately 5,600 acres of critical winter range would actually be disturbed by surface mining and facilities. However, approximately 8,600 acres of the critical winter range could be affected by various mining-related activities. Since Red Rim is a checkerboard Federal-private land ownership area, it is assumed that approximately 4,300 acres of the affected critical winter range would be federally owned and 4,300 acres privately owned.

Table IV-2.--Coal-mining activities that would affect pronghorn using Red Rim

(Source: Moore and Mills, 1977)

Activity	Activity
Surveying.	Fencing.
Drill rig operation.	Cut and fill.
Removal of surface features.	Haulage.
Topsoiling materials storage.	Surfacing and roadbed preparation.
Dewatering.	Mineral storage.
Blasting.	Mineral crushing.
Overburden removal.	Mineral loading.
Overburden disposal.	Operation of railroads.
Mineral extraction.	Operations on access roads.
Topsoiling and revegetation.	Operations on haul roads.
Irrigation.	Fuel and chemical storage.
Operation of machinery and equipment.	Maintenance yards and parking lots.
Clearing and grading.	Operation of electric transmission equipment.
Excavation.	Operation of water supply.
Backfilling and grading	Operation of septic system.
Construction of stream crossings.	Operation of runoff controls.
Dam construction.	Operation of sediment and leach ponds.
Assembly of structures.	

Under reclamation scenario 1, the goal of reclamation would be to reclaim all mined lands within the petition area, including the pronghorn critical winter range, to closely approach its premining condition and carrying capacity. Using the intensive reclamation techniques of this scenario, there would be a 10- to 12-year lag before restored lands could begin to support the premining level of pronghorn use. (See appendix F for a discussion of this reclamation time lag.) Under reclamation scenario 2, there would be a long-term reduction in carrying capacity for wintering pronghorn on approximately 50 percent of the mined lands (2,800 acres) within the critical winter range. Under reclamation scenario 3, there would be a long-term reduction of carrying capacity on 5,600 acres of critical winter range since only some of the topographic and vegetative components essential to wintering pronghorn would be restored. However, given time, some subspecies of sagebrush could become reestablished on reclaimed sites through the process of secondary succession. The long-term loss of critical winter range under reclamation scenarios 2 and 3 would have a long-term adverse impact on the Baggs Herd and the Wyoming GFD management objectives.

Page 5, paragraph 2, states:

> "Red Rim's importance as critical wildlife habitat results from a combination of unique topography and abundance of forage, especially big sagebrush.[4]"

That the topography of the Red Rim area is diverse is confirmed by aerial photographs. BLM notes that "the most significant feature of the Red Rim area is its topography characterized by broken, rolling terrain between the flood plain of Separation Creek to the west and the crest of Red Rim to the east" (Bureau of Land Management, 1981a). BLM also notes that areas immediately adjacent to the Red Rim tract do not have these characteristics (Bureau of Land Management, 1981a). Wyoming GFD describes Red Rim as the only area north of Muddy Creek with the suitable combination of slopes and tall vegetation to shelter pronghorn from winter storms (Wyoming Game and Fish Department, 1981a). Irwin and others (1983) also recognize that the Red Rim area exhibits a complex relationship among vegetation, topography, and climate. See section IIB for a more extensive description of the topography of Red Rim.

The importance of big sagebrush to wintering pronghorn has been discussed in section IIA. Briefly restated, big sagebrush is a preferred winter food for pronghorn on Red Rim and throughout Wyoming. Its availability on Red Rim, in conjunction with shelter, help explain why pronghorn congregate in the area in winter. These factors were considered by Wyoming GFD in its designating the area as critical winter range for the Baggs Herd unit.

OSM agrees that the topography of and forage on the Red Rim winter range contribute to rendering it critical habitat for the Baggs Herd.

Page 5, paragraph 2, states:

> "It is believed that pronghorn traditionally winter on Red Rim, in part because its uplifted, vegetated surfaces are almost always blown clear by winds, while surrounding areas are, and remain, covered with snow.[5]"

Page 7, paragraph 2, alleges:

> "The pronghorn wintering on Red Rim would be most likely to remain there during severe winters because storm patterns create a situation where Red Rim is the only accessible habitat providing their essential needs.[12] Even if alternative winter habitats could be reached by these pronghorn (e.g., during a mild winter), their traditional ties to Red Rim would make abandoning this particular habitat unlikely.[13]"

According to BLM and Wyoming GFD, the 17,582-acre Red Rim critical winter range is one of two such ranges traditionally used by the Baggs Herd (Bureau of Land Management, 1981a). The Muddy Creek critical winter range, totaling 63,300 acres, is located south of Muddy Creek and east of Highway 789. Figure II-3 shows these two critical winter ranges; they are approximately 12 to 25 miles apart and, during most winters, are separated by a snow belt that effectively precludes pronghorn movement between them (Wyoming Game and Fish Department, 1981a). Bruns (1977) studied the winter behavior of pronghorn in relation to their habitat and reported that deep snow presented a barrier to movement and caused the pronghorn to split off into separate groups. Thus, during the winter, after this snowbelt is formed, pronghorn are forced to rely on accessible food and shelter in the area to which they are restricted.

Evidence confirms that pronghorn use Red Rim during the severe winter conditions because adjacent areas do not offer the necessary combination of shelter and highly palatable protein-rich forage to support their survival. The Red Rim area contains unique topographic features not available offsite (Bureau of Land Management, 1981a). The snow belt south of Separation Creek confines pronghorn in the vicinity of Red Rim to that area during the winter by making travel to the southern critical winter range difficult if not impossible. The winter of 1972-73 is considered one of the more severe in recent history in terms of snow depth and low temperatures (Irwin and others, 1984). A March 1973 Landsat photo clearly shows an accumulation of snow surrounding a windswept Red Rim. Moreover, as winter conditions worsen, more pronghorn north of Muddy Creek move in and occupy Red Rim, which is an area traditionally used by pronghorn year after year (Irwin and others, 1984). For these reasons, pronghorn would likely continue to move to Red Rim regardless of whether or not a mine is developed. They would, therefore, have to compete with each other for the limited amount of food and cover available in the area.

Winds contribute to the critical nature of Red Rim as winter range, because they markedly influence snow distribution, forage availability, and pronghorn energy loss and, hence, capacity to survive. Wind velocities in the area are high, increase during the winter, and are generally from the west-southwest. (See section IIH.) Irwin and others (1984) report that, even when snow covers the areas surrounding Red Rim, the ridges and benches of the rim, as well as Separation Creek, remain relatively snowfree. BLM confirms this report, stating that during a critically severe winter ridgetops and southwest- to northwest-facing slopes in the area are windswept and clear of deep snow (Bureau of Land Management, 1981a). BLM also notes that stands of big sagebrush exposed on these windswept sites are heavily used by pronghorn as forage (Bureau of Land Management, 1981a). Bruns (1977) reports that variations in topography affect snow distribution and that pronghorn congregate in areas with low snow cover. Yoakum (1980) concludes that, when snow accumulations exceed 10 to 15 inches, pronghorn frequently experience difficulties in obtaining sufficient forage.

OSM agrees that, during severe winters, pronghorn would continue to use accessible portions of the Red Rim critical winter range.

Page 5, paragraph 2, states:

> "Its many narrow draws serve two complementary purposes. They provide pronghorn with protection from the strong winds.[6] At the same time, because wind-driven snow collects in them, a relatively high-moisture micro-climate is created in these draws. Predictably, greater densities of forage are found in the draws than elsewhere in the vicinity.[7]"

Shelter from winter winds is vital to pronghorn survival. During the severe Wyoming winters, it is essential that pronghorn obtain sufficient nutrition and minimize their energy losses to maintain health. Pronghorn can reduce their energy losses by restricting their movement and by seeking protection from the severe wind chill. Irwin and others (1981) observed pronghorn in the bottom of draws, usually bedded in dense, tall sagebrush cover, during the worst part of storms. Apparently, the leeward side of windswept ridges provides pronghorn with bed grounds protected from the effects of extreme wind chill (Bureau of Land Management, 1981). Bruns (1977) found that pronghorn did occupy microhabitats with climatic conditions significantly more favorable than those of surrounding areas. From instrument readings for temperature, humidity, and wind velocity, he demonstrated that these microhabitats had reduced wind velocities and included such areas as creek banks and the lee sides of tall, dense vegetation. Bruns concluded that pronghorn seeking shelter in protected areas were subjected to 37 percent lower wind velocity than they would have been, occupying open areas.

Draws do collect redistributed snow and, as a result, support big sagebrush stands which are more productive and have higher plant densitites than the surrounding areas. Snow and runoff from the uplands accumulate in the valleys and portions of that moisture are stored in the soil (Bureau of Land Management and others, 1976). The greasewood and big sagebrush communities along Separation Creek, which are used by pronghorn, depend to some extent on this stored moisture. Greasewood on this tract probably belongs to the phreatophytes that are distributed along the major drainageways and that contact and extract moisture directly from the ground-water system. Stands of big sagebrush in other portions of the petition area depend on moisture from entrapped snow which blows off higher topographic features (Bureau of Land Management and others, 1976). Thus, higher soil moisture is not strictly confined to draws and floodplains: BLM and others (1976) found that the lee side of a steep slope, where great quantities of snow accumulated, was the wettest of all sites sampled for moisture in the area. Moreover, the ridge system of Red Rim significantly influences the redistribution of precipitation and the development of soils in the area. Plant communities supported by these soils have greatly enhanced forage production capacities because of the increased amount of effective moisture and differing associated soil characteristics.

Several factors regarding pronghorn use of draws are notable. The sagebrush plants in the draws are not the only sagebrush plants that pronghorn feed on. When snow cover is light, sagebrush in draws is accessible. Pronghorn can feed on this sagebrush and can use the draws for shelter. However, under certain circumstances, heavy snows may make sagebrush in the some of the draws inaccessible and pronghorn would be forced to feed on sagebrush available in windswept areas.

Pages 5 and 6, paragraphs 2 and 1, state:

> "The high density of sagebrush on Red Rim is extremely important in meeting the essential winter dietary needs of this portion of the Baggs pronghorn herd. Up to 95% of the winter diet of these pronghorn is shrubs, primarily big sagebrush.[8]"

Sagebrush and other plant densities are discussed in appendix E. Densities of big sagebrush range from 290 plants per acre in RME's saltbush vegetation type to 7,144 plants per acre in RME's sage vegetation type. (See vegetation table in the "Reclamation Scenario 1" discussion, appendix F.) While density is an important measurement, cover, production, and availability are also important to meeting pronghorn critical winter range requirements. The dietary needs of pronghorn could be achieved by a lower density of shrubs if the total production and its availability were equivalent to the premining level.

Shrubs, particularly big sagebrush, are vital to pronghorn survival. See section IIA for a detailed discussion on the pronghorn-sagebrush relationship.

Pages 6 and 7, paragraphs 3 and 1, state:

> "According to Rocky Mountain Energy Company (RME) personnel, approximately 3,750 acres[10] of the Red Rim coal lease tract will actually be mined. On the other hand, GFD personnel estimate that approximately 9,120 acres of the designated critical wildlife habitat on federal and non-federal land (i.e., 60%[11] of 15,200 acres) would be mined. Neither the 3,750-acre figure nor the 9,120-acre figure includes an estimate of the acreage to be affected by all ancillary activities that will further reduce Red Rim's availability as winter pronghorn habitat."

A substantial portion of the Red Rim critical winter range would be mined over a 30- to 35-year period, but the disturbance would occur in parcels. OSM estimates the critical winter range to cover between 16,870 (based on Wyoming Game and Fish Department (1983)) and 17,582 acres (based on Bureau of Land Management, written communication, February 7, 1983; see appendix I). Using information from RME's preliminary mining plan (D. H. Emling Company, 1978), and considering other factors such as spoil piles, facilities, and other "ancillary activities," OSM estimates that approximately 8,600 acres within the critical winter range would be subject to various mining-related disturbances. This represents 51 percent and 49 percent, respectively, of the Wyoming GFD and BLM critical winter range delineations (Bureau of Land Management, written communication, February 7, 1983; see appendix I). Approximately 5,600 acres of critical winter range would actually be disturbed by surface mining and facilities.

Although some 8,600 acres could be affected, it is noted that: (1) only small areas for buildings, loadout facilities, and some roads would be disturbed for the entire life of the mine, (2) most areas would be disturbed sequentially in parcels averaging about 350 acres per year (table IV-1), (3) successfully revegetated areas would support some level of pronghorn use after 10 to 12 years (appendix F), (4) a maximum of 4,900 mined and unreclaimed acres (most of them lying within the delineated critical winter range) would be unavailable to pronghorn during the life of the mine (table IV-1), and (5) some areas between pits and stockpiles would be suitable for and accessible to pronghorn. The value of undisturbed areas between pits, roads, and stockpiles is arguable. However, it is not known how suitable and accessible the undisturbed areas would be. Spoil piles and pits would influence snow distribution and affect forage availability and pronghorn movements. Pits, piles, and fences would alter accessibility of those areas normally preferred by pronghorn during harsh winter conditions.

OSM does not agree with estimates the petitioners cite of the acreage that would be disturbed should Red Rim be mined. OSM has based the analyses presented in this PED/EIS on estimates it derived as noted in section IVA.

Page 7, paragraph 1, alleges:

> "Since reclamation of Red Rim (including that contemplated during the life of the mining operations) appears to be technologically and economically infeasible (see section b., below) critical habitat available to pronghorn would be greatly diminished in size and quality during the life of the mining operation and for the forseeable future."

(The "section b." (page 9 of the petition) referred to in this allegation is that "Reclamation is not technologically and economically feasible under the Surface Mining Control and Reclamation Act of 1977 (30 U.S.C. 1201, et seq.).")

Whether Red Rim could technologically and economically be reclaimed is discussed in section IVC.

Regardless of whether or not Red Rim could be reclaimed, the carrying capacity of the critical winter range would be reduced during mining and reclamation.

Page 7, paragraph 3, states:

> "Thus, mining operations would lead to crowding of the animals on Red Rim. The result would be large-scale nutritive deficiency which would lead to decreased survival of wintering pronghorn and reduced reproductive rates."

If mining were to occur, the Wyoming GFD would attempt to reduce the Baggs Herd to a level lower than its 1985 population management objective to compensate for a new, lower carrying capacity due to mining (Harry Harju, Wyoming Game and Fish Department, oral communication, 1983). This would be done to utilize surplus animals and to prevent pronghorn from overgrazing unaffected lands. If, however, this reduction were not achieved, pronghorn would be forced to rely on a smaller amount of limited resources. This, in turn, would damage the range and reduce the area's capability to support wintering pronghorn. Moreover, the increased grazing pressure would increasingly deplete the already limited browse on Red Rim. Pronghorn would then be forced to switch from their preferred foods to staple species and finally to emergency foods (Leopold, 1944). However, only the preferred and staple species provide the nutrition necessary to sustain pronghorn through the winter. As a result, there would be increased winter mortality and reduced productivity due to poor nutrition.

Pages 7 and 8, paragraphs 3 and 1, state:

> "During severe winters, herd loss would be directly proportional to habitat loss,[14] e.g., if 35% of Red Rim was disturbed, predictably 420 to 980 pronghorn would be lost.[15]"

For the purpose of estimating pronghorn mortality during severe winters, OSM assumed that (1) herd loss would be directly proportional to habitat loss, as the petitioners allege; (2) the population-management objective for the Baggs Herd would be 7,200 pronghorn (i.e., Wyoming GFD would not lower the current population-management objective prior to mining to compensate for an anticipated lower carrying capacity owing to mining); (3) one-third of the herd would depend upon the 19,452-acre Red Rim petition area for survival (Wyoming GFD estimate; based on the assumptions that a maximum of 2,400 pronghorn would use Red Rim and that the population-management objective for the herd would remain at 7,200 pronghorn); (4) mining and reclamation of the tract would occur as discussed in section IVA (disturbance acreages for each year of the 42 year life-of-mine, assuming 12 years for reclamation, are shown in table IV-1); (5) severe winters would occur once every 5 years (based on data from Irwin and others (1984) and taking account of the severe winter of 1983-84); (6) pronghorn mortality owing to mining-related habitat loss would occur only during severe winters; (7) during the period intervening between severe winters, the herd, which would have been reduced in number by severe weather, would gradually increase back up to 7,200 pronghorn; and (8) the area avoided by pronghorn during mining and reclamation would, on average, be twice as large as the area actually disturbed by these activities (based on Segerstrom (1982)).

Calculating based on these assumptions, OSM found that pronghorn mortality would range from 53 to 1,205 (0.7 to 17 percent of the herd) if severe winters occurred during the years of minimum and maximum unreclaimed mining disturbances (years 1 and 21; table IV-1). To estimate the cumulative loss of pronghorn over the life of the mine, OSM assumed that severe winters would occur in years 1, 6, 11, 16, 21, 26, 31, 36, and 41 of the mining operation. Based on this assumption, mortality for pronghorn over the life of the mine would be 6,797 (53, 502, 828, 1,134, 1,205, 1,112, 1,130, 631, and 202 pronghorn respectively for the years indicated). This estimate describes the number of pronghorn that would die over the short term (during the life of the mine) as the direct result of habitat not being available to them owing to ongoing mining and reclamations; pronghorn lost in this manner would be additional to those lost from natural causes, irrespective of mining, during severe winters.

Dr A. William Alldredge's (a wildlife biologist and expert witness for the petitioners) estimate of how many pronghorn would die owing to mining differs from the petitioners' and OSM's estimates. He estimates that 1,600 to 2,000 pronghorn from the Baggs Herd would die during a severe winter owing to habitat loss on Red Rim (A. William Alldredge, written communication, February 6, 1985).

The carrying capacity of Red Rim's pronghorn critical winter range is a measure of the range's capability to support pronghorn through the winter. Once mining began, pronghorn mortality during a given year would relate directly to how much this carrying capacity was reduced by mining and reclamation operations over the course of the year. If successful, and given enough time, reclamation could restore the range's premining carrying capacity. OSM estimates that a maximum of 4,053 acres of critical winter range would be unreclaimed at any one time during mining. Pronghorn would avoid this unreclaimed area, because mining, reclamation, and human activities would be ongoing; OSM assumes that they would also avoid an unmined area approximately equal to that acreage but surrounding it. Therefore, during years of maximum disturbance, about 8,106 acres, or 46 percent of the total critical winter range, would be unavailable for pronghorn use. As a result, the carrying capacity of the critical winter range would at most be reduced by 46 percent over the short term under reclamation scenarios 1, 2, and 3. Over the long term, the carrying capacity of the range would be reduced by some lesser percentage under reclamation scenarios 2 and 3.

OSM's assumptions that pronghorn would die from mining-related causes only during severe winters and that mortality would be directly proportional to habitat loss are valid in the context of approximating mortality. However, pronghorn may die from mining-related causes not only during severe winters but during other winters as well. The weather at Red Rim would compound the effect of adverse conditions (for example, overcrowding, stress, and range deterioration) pronghorn would be subject to as the result of mining. If the cumulative impact of these conditions on the pronghorn population were sufficiently adverse, that population may be less able to withstand comparatively mild winters. In consequence, pronghorn could be killed by weather they would have survived prior to mining. In addition, for herd loss to be directly proportional to habitat loss, pronghorn would have to distribute themselves evenly across Red Rim. However, Irwin and others (1984) found that some portions of the Red Rim area support more pronghorn during the winter than do others. To determine where pronghorn concentrate at Red Rim, Irwin and others divided a 24,621-acre study area, which contains the entire 17,582-acre critical winter range designated by Wyoming GFD (fig. II-1), into four different subareas (the Red Rim, the Separation Creek, the Central, and the North subareas). Table IV-3 shows the percentages of Red Rim winter pronghorn population occupying the four subareas delineated by Irwin and others (1984; fig. IV-1).

As table IV-3 shows, the Separation Creek subarea represents only one-third of the total study area but supports nearly one-half of the wintering pronghorn population. Likewise, the Red Rim subarea, 23 percent of the total area, supports almost 29 percent of the pronghorn. However, the Northeast subarea, which comprises almost 27 percent of the total area, supports only 7.5 percent of the pronghorn. Clearly, then, more pronghorn would be affected if 100 acres were disturbed in the Separation Creek subarea than would be if 100 acres were disturbed in the Northeast subarea. However, Dr. Irwin predicts that pronghorn populations in the Central and Northeast subareas, which normally support comparatively fewer pronghorn, would increase considerably during severe winters (Dr. Larry L. Irwin, University of Wyoming, written communication, January 29, 1985). Therefore, disturbance of these subareas could still result in significant losses of pronghorn.

BLM's current mitigation requirements for the proposed Red Rim coal lease tract (appendix J) stipulate enforcement of a pronghorn no surface occupancy area and a Separation Creek riparian zone no surface occupancy area, which would protect a portion of the Red Rim and Separation Creek subareas from mining and surface disturbance. (Plate 1 in the back of this volume of the PED/EIS shows the pronghorn no surface occupancy area and the ¼-mile Separation Creek riparian zone on each side of Separation Creek.) Enforcement of BLM's stipulation in the areas of highest winter pronghorn concentration would partially mitigate the impacts to the pronghorn using the Red Rim petition area.

Table IV-3.--Winter pronghorn populations in the four subareas delineated by Irwin and others (1984) for the Red Rim study area

Study subarea	Approximate acreage	Percentage of total Red Rim study-area acreage	Average percentage of study area pronghorn population (1978-82)
Separation Creek	8,200	33.3	47.3
Northeast	6,747	27.4	7.5
Red Rim	5,434	22.1	28.5
Central	4,240	17.2	16.7

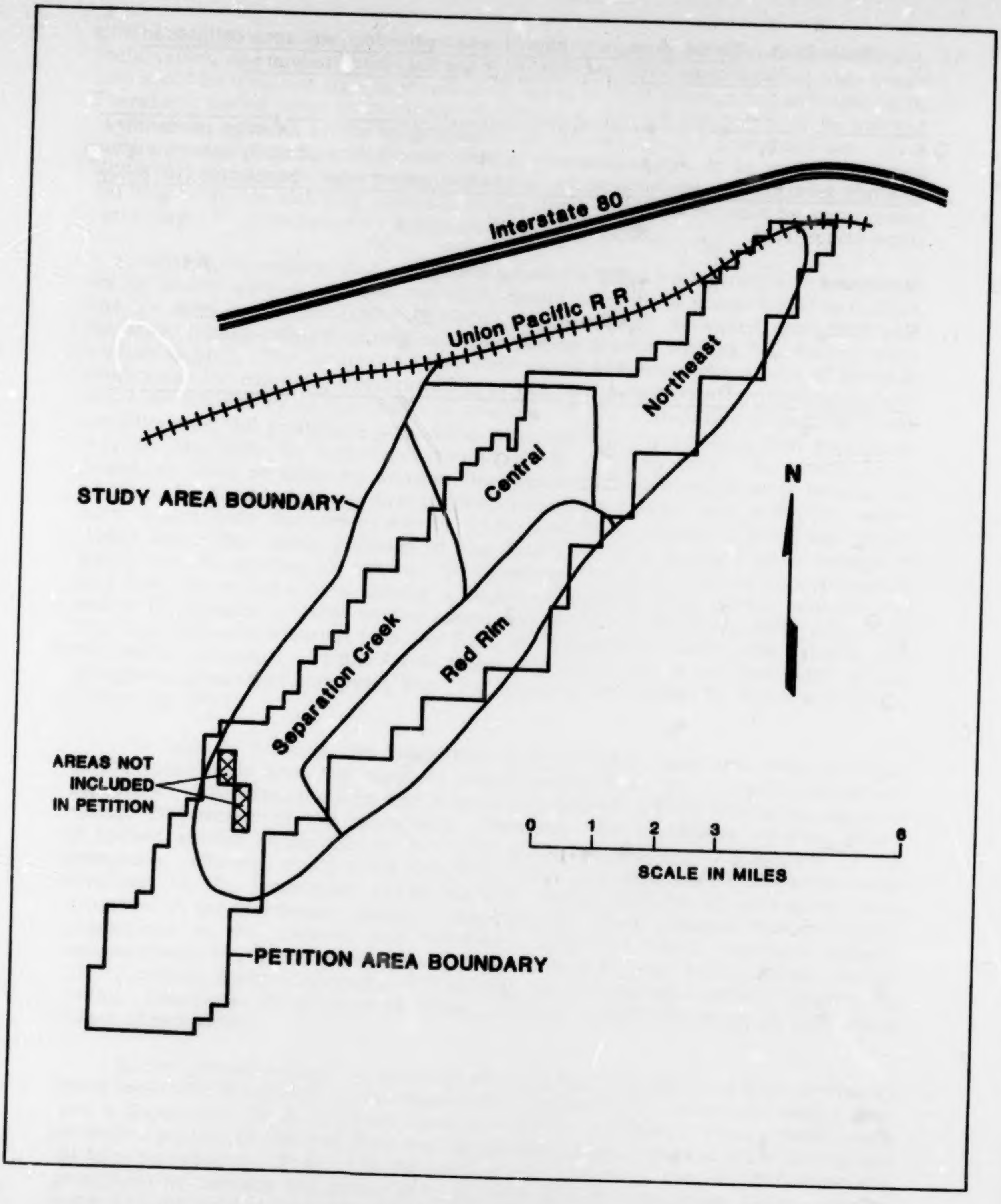

Interstate 80
Union Pacific R R
Northeast
Central
STUDY AREA BOUNDARY
N
Separation Creek
Red Rim
AREAS NOT INCLUDED IN PETITION
0
1
2
3
6
SCALE IN MILES
PETITION AREA BOUNDARY

Figure IV-1.--The four subareas delineated by Irwin and others (1984) for the Red Rim study area.

The petitioners' allegation and OSM's analysis do not consider that Wyoming GFD would probably attempt to reduce the pronghorn population in anticipation of a new, lower carrying capacity owing to mining (Harry Harju, Wyoming Game and Fish Department, oral communication, 1983). This reduction would be made to avoid overcrowding, depletion of limited winter forage, and losses from starvation. If Wyoming GFD were successful in (1) setting a reduced population-management objective that accurately reflected the reduced carrying capacity of Red Rim and (2) reducing the herd to this new level throughout the life of the mine, pronghorn losses in severe winters, over and above natural losses, should not occur. Nevertheless, the pronghorn that would be harvested through increased hunting-license sales throughout the life of the mine would be the direct result of habitat loss on Red Rim. (Note that RME estimates that, to take account of the average amount of disturbance over the life of the mine, Wyoming GFD would have to reduce its population-management objective by 216 pronghorn (ElRoy Taylor, Rocky Mountain Energy Company, February 6, 1985).)

OSM's analysis here considers only the pronghorn that would die over the short term as the direct result of habitat loss on Red Rim. However, several other factors could account for considerable additional short-term and long-term losses. Among these are that (1) fences, spoil piles, pits, and other mining-related disturbances and facilities would exclude pronghorn from portions of the critical winter range, exposing them to the elements during severe snowstorms and causing them to overexert themselves to move around barriers and to locate shelter and accessible forage elsewhere; exposure and overexertion would, in turn, lead to increased mortality and decreased reproductive capability; (2) fences could entangle pronghorn trying to cross them or otherwise entrap pronghorn during severe snowstorms; (3) poaching, road kills, and harassment would increase owing to the influx and increased activity of people in the Red Rim area; and (4) alteration of the topography and vegetation patterns of the area, reduction of vegetation densities and diversity, and reduction of forage available to pronghorn would reduce not only the short-term (reclamation scenarios 1, 2, and 3) but also the long-term (reclamation scenarios 2 and 3) carrying capacity of the critical winter range.

OSM concludes that a maximum of 1,205 (17 percent of the Baggs Herd) could die during any single winter and that approximately 6,800 pronghorn could die during the life of the mine owing to the short-term loss of habitat directly resulting from mining. OSM considers this a significant impact to the Baggs Herd. This estimate does not account for additional short- and long-term losses that could result from other mining-related factors.

Page 8, paragraph 1, states:

> "There would also be a cumulative loss of progeny over the life of the mine.[16]"

The Wyoming GFD management objective is to maintain herds in balance with the habitat capabilities. One tool used to maintain this balance is hunter harvest of antelope based on the herd productivity. Since mining could result in a long-term reduction in carrying capacity there would be a lower population and a lower production of progeny during the life of the mine and for many years after mining has ceased.

Wyoming GFD periodically sets a population-management objective for the Baggs Herd. As an example, the 1985 objective for the herd is 7,200 pronghorn; the herd is currently below this level. The objective is related to, though not solely dependent upon, the current carrying capacity of both Muddy Creek and Red Rim critical winter ranges. (Objectives are also related to other game-management considerations and to sociopolitics, the desires of various publics (Francis Petera, Assistant Director, Operations, Wyoming Game and Fish Department, written communication, January 6, 1984).) Since mining would reduce the carrying capacity, Wyoming GFD would either have to somehow increase the carrying capacity of the winter range the pronghorn displaced from Red Rim by mining would use or accept a lower posthunt population objective. Owing to uncertainties about whether the carrying capacity of areas off the site could be appreciably increased to compensate for the loss of the Red Rim critical winter range during mining and reclamation and whether proghorn would or could actually use these areas, Wyoming GFD would probably select the latter alternative. It would attempt to reduce the herd prior to mine development to protect habitat quality (Harry Harju, Wyoming Game and Fish Department, oral communication, 1983). Assuming the herd was above objective and had to be reduced, once the objective was reached, Wyoming GFD would have to set harvest limits at a new, lower level.

The cumulative impact of loss of production would depend on several factors, including:

- The accuracy of the assumptions used to predict fawn:doe ratios and pronghorn mortality.
- The difference between the proposed population objective and the hypothetical lower objective, revised to account for a reduced carrying capacity.
- The amount and quality of habitat disturbed by mining and the duration of that disturbance.
- The condition of the critical winter range and its capability to support displaced pronghorn.
- The success of reclaiming disturbed areas to their premining carrying capacities.
- The frequency and duration of severe winters.

Page 8, paragraph 2, alleges:

> "This threatened loss of pronghorn is unacceptable. Pronghorn are a comparatively unique species. They are among the fastest mammals, attaining speeds of about 55 miles per hour. Found primarily in the State of Wyoming, the pronghorn as a species is one of the few in the world that constitutes the entirety of a biological family. Thus, any threat to this species would pose a danger to the whole family. In addition, the group wintering on Red Rim is scientifically unique, due to their unusual fidelity to a single habitat.[17] The loss of these pronghorn would be tragic, both economically[18] and scientifically. Since the effects of the significant disturbance and permanent alteration of a large por-

tion of their wintering area are at best predictably adverse, and at worst disastrous, such activities should not be permitted."

In any mining and reclamation scenario, the Red Rim pronghorn population would only be reduced, not lost. There would still be a population of pronghorn for scientific research. Irwin (affidavit to the petition, written communication, 1983; see appendix A) stated, without advocation, that, if the Red Rim area were to be mined, scientific data on pronghorn response should be collected. Wyoming DEQ routinely requires, as a condition of a mining permit, that an applicant to mine coal commit to monitoring wildlife and, in some cases, to conducting special research on them. Mining would leave portions of the Red Rim tract undisturbed, because portions of the tract would not be mined or occupied by mine-related facilities.

Irwin and others (1984) stated that many pronghorn move to specific, traditional areas each winter and that Red Rim is only one of those areas used year after year. In no case would mining of Red Rim cause the elimination of the entire 7,200 pronghorn in the herd (1985 Wyoming GFD population objective): the Baggs Herd would only be temporarily reduced under reclamation scenario 1; reclamation scenarios 2 and 3 would result in long-term reductions of the herd. The approximately 33,912 pronghorn (1983 estimate) in adjacent herds in Wyoming and Colorado (fig. II-3; table II-2) would be unaffected; an additional 366,100 pronghorn (1983 estimate) in other parts of Wyoming and pronghorn in all other States would also be unaffected. Therefore, under no circumstances could mining on Red Rim be construed as a threat to the entire pronghorn species.

There is no site-specific information to document the revenue generated from pronghorn hunting on Red Rim alone. Red Rim is within the South Rawlins Hunt Area that, combined with the Baggs Hunt Area, comprise the Baggs Herd Unit. Based on 1981 data, 2,439 hunters sought pronghorn in the Baggs Herd Unit. Of these hunters, 1,042 hunted in the South Rawlins area and spent $168,591 for licenses and hunt-related expenses. If the Red Rim tract were leased and if a mine plan were approved, the Wyoming GFD would reduce the herd to fit a lower carrying capacity (Harry Harju, Wyoming Game and Fish Department, oral communication, 1983). Additional licenses and special seasons would be necessary until the desired population was achieved. In the short term, there would be an increase in revenue from license sales and hunt-related spending. Once the new, lower population objective was achieved, the Wyoming GFD could set a lower harvest number and, therefore, issue fewer licenses. Wyoming GFD data indicate that the average nonresident pronghorn hunter spends $368 and a resident $117. The annual revenue loss would depend on the difference between the 1985 Wyoming GFD population objective and the new, lower level set to fit a lower carrying capacity. This spending loss would continue as long as Red Rim's carrying capacity is below the premine capacity. This analysis of hunter-generated revenues assumes that hunters would buy all or nearly all of the pronghorn licenses which Wyoming GFD would offer for sale at current prices and that hunters using these licenses would be highly successful. In 1981, only 58 out of 1,100 available licenses in the South Rawlins Hunt Area and 103 out of 1,500 available licenses in the Baggs Hunt Area were not bought by hunters; the hunter success on the licenses was 92.7 and 90.1 percent, respectively, for the two hunt areas (Walt Gasson, Wyoming Game and Fish Department, written communication, September 19, 1983).

Under reclamation scenario 1, impacts on hunter-related expenditures would be minimal. Under reclamation scenarios 2 and 3, there would be a long-term loss of hunter-related expenditures since the Red Rim carrying capacity would be reduced.

The carrying capacity of Red Rim critical winter range would be reduced in the long term (longer than 40 to 45 years) under reclamation scenarios 2 and 3, and in the short term under reclamation scenario 1. The reduction would be greatest under scenario 3, since less emphasis would be placed on the complex reestablishment of big sagebrush communities.

OSM does not agree that the pronghorn species would be threatened by mining on Red Rim. However, OSM does conclude that hunter-related revenues could decrease considerably owing to pronghorn losses resulting from mining and mining-related activities.

C. RESPONSES TO ALLEGATION 2

The major issue of allegation 2 is that "Reclamation is not technologically and economically feasible under the Surface Mining Control and Reclamation Act of 1977 (30 U.S.C., Section 1201, et seq.)." The petition contains statements in support of this allegation. Certain of these statements are quoted below, followed by OSM's analysis of them.

Pages 9 and 10, paragraphs 2 and 1, allege:

> "Therefore, reclamation would require restoration of both pre-mining drainage patterns (to provide the numerous small draws offering essential shelter to pronghorn and increased moisture to vegetation) and pre-mining vegetative patterns (to provide the essential dietary needs of pronghorn) as discussed above in section a."

(The "section a." (page 3 of the petition) referred to in this allegation is that "Surface coal mining operations will adversely affect fragile land which is valuable habitat for pronghorn antelope.")

Specific existing features of Red Rim's diverse topography provide shelter, concentrated moisture, and windswept exposures. Sundstrom and others (1973) recommended that optimum pronghorn habitat feature an irregular landscape capable of lessening the debilitating influences of cold winter and early spring winds and of facilitating the availability of forage through exposure by wind and sun. Bruns (1977) recommended that critical winter ranges might best be conserved or improved by creating microhabitats that have shallow, soft snow, and protection from wind on them. BLM (1981a) affirmed that disturbed critical winter ranges must be reclaimed to topographic forms suitable as pronghorn habitat. Irwin and others (1984) reported that Red Rim pronghorn congregated in snow-free areas, generally moderately sloping, northwest exposures.

There are no known data to quantify the exact number and types of topographic features that would be necessary to restore reclaimed lands to a condition equal or superior to the premine condition for wintering pronghorn. Irwin and others (1984) stated that the entire Red Rim area is important, that features along Separation Creek are important during normal winters, and that snow-free areas are necessary during severe winter conditions. (Note: The areas along

Separation Creek would be protected from disturbance by BLM's Separation Creek riparian no surface occupancy area (plate 1); the Red Rim Escarpment and the upper reaches of draws to the west of it would not be disturbed, owing to the absence of recoverable coal (plate 1) and BLM's pronghorn no surface occupancy area (plate 1).) Additional studies, such as the lessee's habitat and recovery plan required in BLM's mitigation requirements for the proposed lease area (appendix J, mitigation requirement No. 11), could, at the mine permitting stage, refine OSM's understanding of the complex vegetation-topography-pronghorn relationships.

OSM agrees that, following mining, the topography of the petition area would have to be restored to some acceptable configuration; however, the successful lessee of the proposed coal lease tract would not establish specific features within that configuration until after it had leased the tract, prior to its permitting.

Regarding vegetation patterns, OSM believes that the key factors for critical winter range are sufficient quantities of big sagebrush available in accessible areas. A revegetation plan could and should be tailored to establish the desired cover, density, and production of big sagebrush in and adjacent to snow-free areas. The exact pattern could vary from the premine patterns, so long as these objectives were met. In addition, the small depressional areas which have large concentrations of vigorously growing sagebrush would have to be reestablished.

The petition specifically addresses the reestablishment of big sagebrush and its relationship to maintenance of the pronghorn herd. Revegetation to meet all or most of the critical winter habitat needs of the pronghorn could be accomplished by successful implementation of all of the components of reclamation scenario 1. The probability of success in utilizing reclamation scenario 1 (see appendix F, table F-1) is dependent, minimally, on quality of baseline inventories, their utilization and integration into a reclamation planning effort, the lessee's reclamation skill and persistence, the state of knowledge of shrub establishment, as well as on the probability of severe drought. In no case would the revegetation take place in a short period of time. Ten to twelve years after spoil regrading and planting would be required before the site could be expected to support a portion of the premining levels of pronghorn if all factors were optimal (appendix F). Livestock exclusion from the reclaimed area under the goals and methods described in reclamation scenario 1 would probably be required for 10 years for bond release. This 10- to 12-year time period for some recovery of the habitat is only an estimate of time required to allow some pronghorn use. Variables which could significantly affect this estimate include amount and distribution of precipitation, soil and topographic variables, and the plant species used in the reclamation effort. Livestock exclusion may have to be extended to 12 to 20 years, depending upon precipitation and the degree of success in vegetative reestablishment, to ensure that the developing postmine plant communities are not damaged and that the revegetation effort is successful. Additionally, stringent measures would have to be instituted to prevent pronghorn and other wildlife utilization during the first 2 or 3 years. In several reclamation trials described by Howard, Rauzi, and Schuman (1979), pronghorn and other wildlife species destroyed shrub revegetation efforts.

There is no evidence to suggest that revegetation of the Red Rim area to the reclamation scenario 3 condition is improbable. Based on experience in coal revegetation work on surface mines in the Hanna and Rock Springs, Wyoming, area, it should be possible to establish a vegetative cover (absolute) of 15 to 40 percent, given currently available technologies. Shrub reestablishment appears probable, although it will be much more difficult than establishment of the 15 to 40 percent vegetative cover parameter mentioned above (Coenenberg, 1982; DePuit and Coenenberg, 1980; Sindelar and Platenberg, 1980). The success, albeit in a short timeframe, of revegetation with Nuttall's saltbush (Atriplex nuttallii), fourwing saltbush (Atriplex canescens), and shadscale (Atriplex confertifolia) should be possible. Their specific adaptation to the very harsh, arid environments, coupled with tolerance of relatively high levels of salinity and alkalinity, would suggest that these shrub species could be established on this site. In addition, these species have been successfully established on many western mine reclamation projects. The reestablishment of relatively high absolute cover values on topographic features susceptible to wind removal of snow cover, as would be desirable for pronghorn use on Red Rim, would be much more difficult.

Summarizing the above revegetation discussion, revegetation to a multiple-use native grassland condition (reclamation scenario 3) is highly probable; revegetation primarily to meet critical pronghorn habitat requirements (reclamation scenario 1) would be possible, but the certainty of its success would be less. (For further discussion on this point, see OSM's response to statements in support of allegation 2, as well as appendix F and table F-1.) Considerable risk exists in fully restoring pronghorn critical winter range. However, if the Federal lease, Wyoming DEQ, and OSM require this level of reclamation, the mining and reclamation plan would have to show that it could be achieved before a permit to mine could be granted.

Subject to the reservations discussed above, it appears possible that the complex establishment of big sagebrush communities could be accomplished under reclamation scenario 1. Under this scenario, there would be a short-term reduction in carrying capacity on the entire mine area. Under reclamation scenario 2, there would be a long-term reduction of carrying capacity for wintering pronghorn on that half of the area reclaimed to multiple-use native grassland (as in reclamation scenario 3), and there would be a short-term reduction in carrying capacity on the other half of the area reclaimed to pronghorn critical winter range (as in reclamation scenario 1). Under reclamation scenario 3, there would be a long-term reduction of carrying capacity on the entire mine area, since all disturbed critical winter range would be reclaimed to a multiple-use native grassland with significantly less emphasis on restoration of sagebrush communities.

Page 10, paragraph 1, states:

> "To preclude decimation of the 1,200 to 2,800 pronghorn herd wintering on Red Rim (a substantial portion of the Baggs herd), prompt restoration of this critical winter range to its former carrying capacity would be essential."

Any mining operation on Red Rim would result in the following effects on pronghorn: (1) habitat would be disturbed and reclaimed in parcels (see table IV-1 for year-by-year disturbances), (2) some areas of critical winter range would be undisturbed and accessible to pronghorn, and (3) reclaimed lands would support some level of pronghorn use 10 to 12 years after planting. (See appendix F for a discussion of this reclamation time lag.) Therefore, the carrying capacity of Red Rim would be reduced and reclaimed in stages. Prior to mine development, the Wyoming GFD would attempt to reduce the herd to a level compatible with the lower, short-term carrying capacity (Harry Harju, Wyoming Game and Fish Department, oral communication, 1983). This would minimize overcrowding on those portions of Red Rim and adjacent areas which are undisturbed and would reduce the potential for major losses during severe winters.

Under reclamation scenario 1, there would be a short-term population reduction in the pronghorn herd wintering on Red Rim. The pronghorn population would return to premining levels as the mined areas were returned to premining carrying capacity. Under reclamation scenario 2, there would be a long-term (longer than 40 to 45 years) reduction of carrying capacity on 2,800 acres of habitat within the critical winter range delineation. This reduction would affect 16 percent of the total critical winter range. Under reclamation scenario 3, there would be a long-term reduction of carrying capacity on 5,600 acres of habitat within the critical winter range delineation. This reduction would occur on 32 percent of the critical winter range (all mined lands within the critical winter range).

OSM disagrees that the pronghorn using Red Rim would be decimated by mining. However, OSM does conclude that pronghorn losses would occur over the short term (OSM's estimates of the extent of these losses are given in the response to a previous allegation) and possibly over the long term.

Page 11, paragraph 3, alleges:

> "Furthermore, restoration to a smoother, rolling topography would cause greater exposure of the pronghorns to the adverse effects of bitter winter winds. This would create a need for greater quantities of forage, as the animals would have to eat more to maintain their body heat. If they congregated in the undisturbed draws, greater stress to the herd would result, and over-use of the vegetation in those areas would probably occur.[22]"

The need for protection from the harsh winter winds has been discussed in chapter II and earlier in this chapter. Without such protection, even the healthiest pronghorn would succumb to exposure. Taylor (1981) reported that pronghorn died of exposure despite being well fed and in good health. Reclamation should include enough protective features to preclude crowding, browse depletion, and starvation.

Pages 10 and 11, paragraphs 3 and 1, allege:

> "Restoration to the pre-mining use of pronghorn winter range of the same or better than pre-mining quality would require a program of micro-contouring to recreate drainage patterns and rebuild the backbone-like configuration of the primary and secondary ridges that presently exist and are necessary to provide the animals' winter needs.[19] To accomplish such a micro-contouring program, accurate maps of the land must first be prepared before disturbance. After disturbance, bulldozers must reposition the overburden and topsoil in conformity with these maps. Until new vegetation took hold, substantial repair and maintenance would be required to preserve the restored draws and replaced topsoil.[20]"

Page 11, paragraph 2, alleges:

> "Failure to achieve this topographic restoration would result in less winter forage for two reasons. First, absent secondary ridges, less exposed vegetation would be available during snowy periods (the secondary ridges are windswept in the same manner as the main ridge). Also, the draws formed between the ridges protect growing forage and hold moisture to encourage more profuse growth of forage.[21]"

The Red Rim Escarpment and the upper reaches of most draws would not be mined, because (1) these uplands do not overlie mineable coal beds and (2) they are precluded from mining as being within BLM's pronghorn no surface occupancy area. At this time, there is no information available that quantifies the exact numbers and designs of specific features of Red Rim's diverse topography that would be mined and would have to be restored in order for the area to support the premining populations of pronghorn. Under reclamation scenario 1, an intensive effort would be made to restore topographic features on mined lands in the petition area. (See appendix F, reclamation scenario 1.) Under reclamation scenario 2, topographic restoration necessary for critical winter range would be attempted only on half the lands to be mined. Under reclamation scenario 3, the topography would be restored to approximate original contour as required by Wyoming DEQ rules and regulations. This would result in a postmining topography which is less diverse that the premining condition. This analysis concentrates on the topographic impacts of reclamation scenarios 1 and 3 since the impacts of reclamation scenario 2 generally fall midway between the two.

OSM identified through analysis some of the important factors that could be used as tests of achievement of restoration of the preexisting landscape. The analyses were performed on T. 19 N., R. 90 W., sec. 5, and T. 20 N., R. 90 W., sec. 33, and at other selected locations on the petition area. Those sections were chosen for analysis because they are located within the pronghorn critical winter range, contain many diverse topographic features, and were proposed to be mined under RME's preliminary mining plan (D. H. Emling Company, 1978).

The existing topography is composed of several northeast-southwest trending hogback ridges, capped by resistant sandstone beds of the Fort Union Formation. Superimposed on these ridges are drainages, mostly tributary to Separation Creek, which traverse the dipslopes of the hogback ridges or flow within the interridge valleys (fig. IV-2). These interridge valleys are typically underlain by the less resistant strata of the Fort Union Formation. The channels that flow down the dipslopes have incised the bedrock to create secondary ridges approximately perpendicular to the mainridges. The dipslope valleys are rather steep sided; many of the larger ones have flat alluvial bottoms. Several of the alluvial bottoms have gullies. Figure IV-3 shows the rose plots of hillslope aspect (facing direction) frequencies of the existing (and reclamation scenario 1) and a postmining (reclamation scenario 3) landscape. Most slopes fall into the west-northwest, northwest, and north-northwest facing slope classes. (Note that this frequency analysis was performed by measuring aspect and gradient at points determined by by an overlay dot grid placed on a topographic contour map. Sixteen aspect classes were chosen at principal compass points. Any convenient azimuth interval could have been used. Hillslope gradient was measured at the same points, by measuring the distance between contour lines adjacent to the grid point. The map distance is converted to ground distance and divided into the contour interval. The contour interval of the maps used is 20 feet.) Figure IV-4 shows the rose plots of frequencies of the average hillslope gradient in each aspect class for the premining

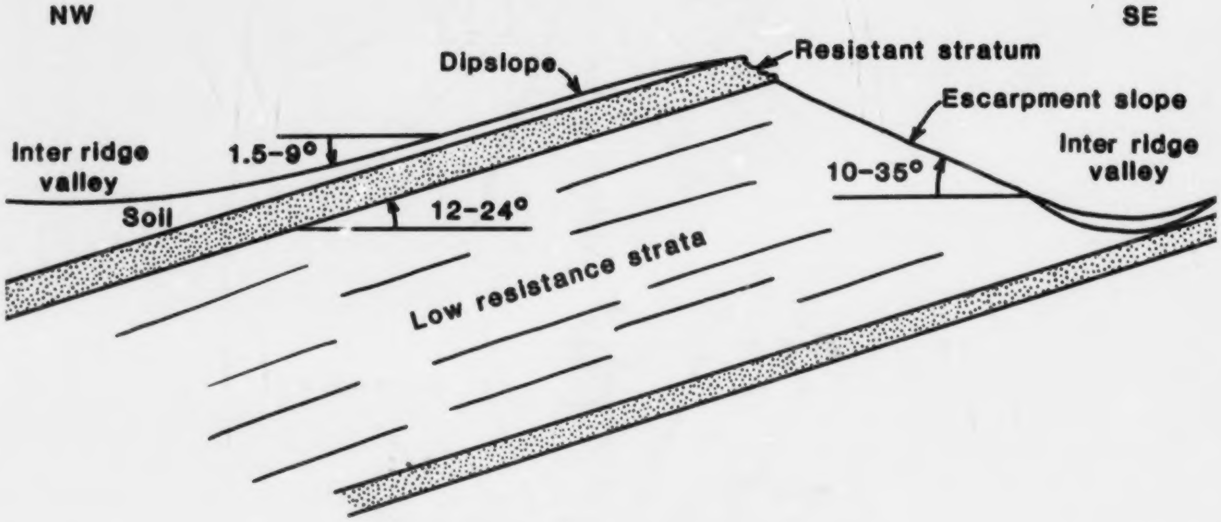

NW
SE
Dipslope
Resistant stratum
Escarpment slope
Inter ridge valley
1.5-9°
10-35°
Inter ridge valley
Soil
12-24°
Low resistance strata

Figure IV-2.--Cross section diagram of relationships of typical bedrock, topography, and soils on the Red Rim area, as viewed toward the northeast.

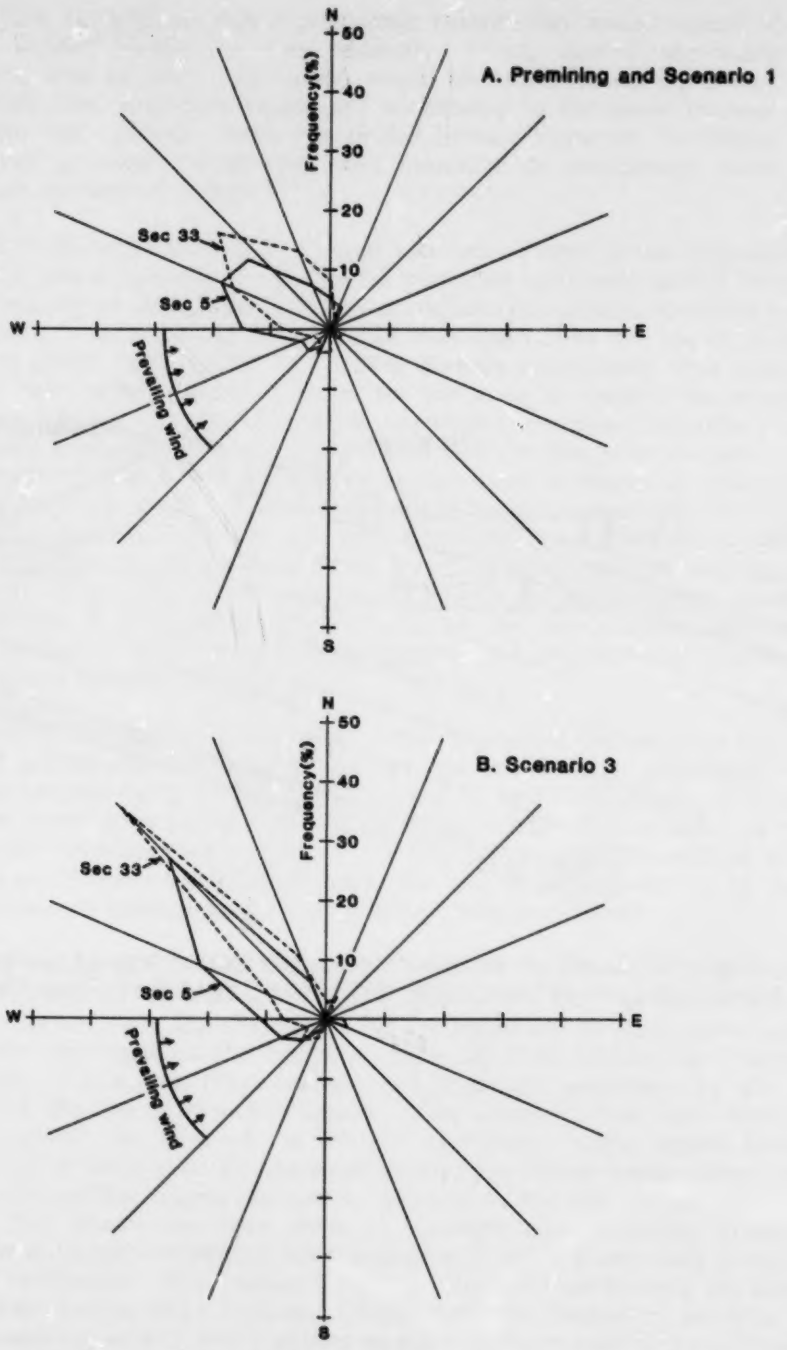
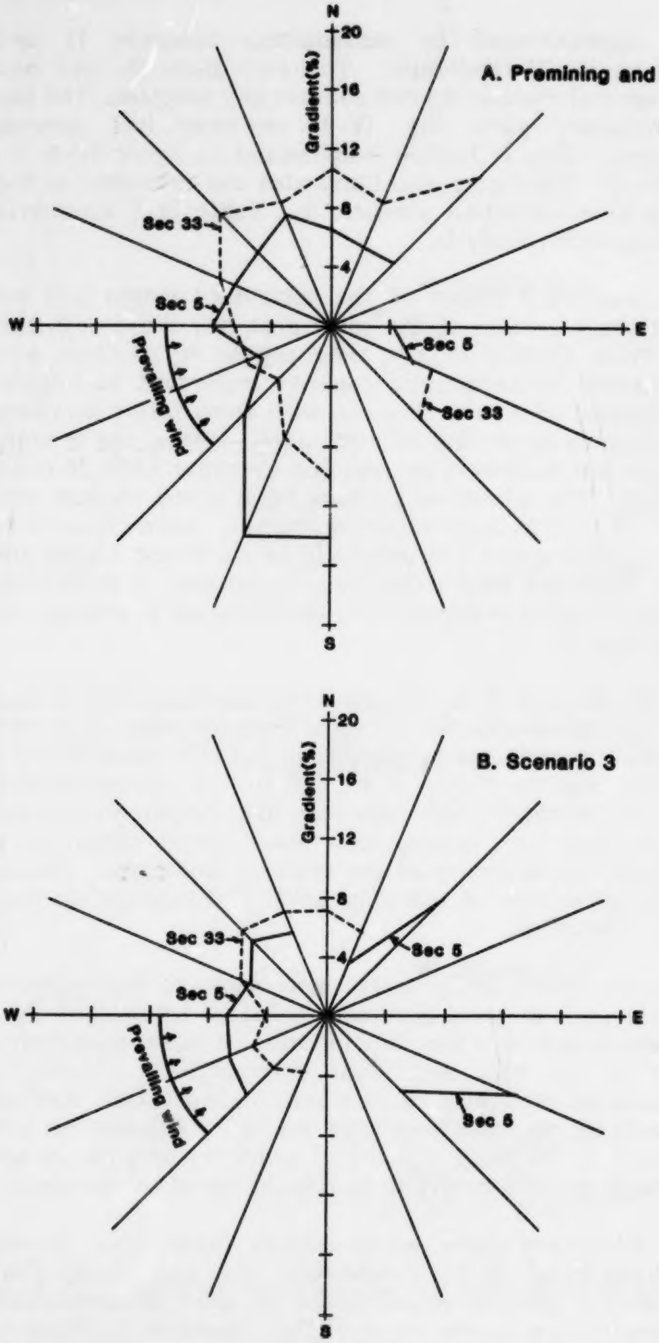


Figure IV-3.--Rose plots showing wind direction and relative frequency of hillslope aspects for the premining and a postmining landscape in T. 19 N., R. 90 W., sec. 5 and in T. 20 N., R. 90 W., sec. 33. Diagram A represents the premining condition taken from a 7.5-minute USGS topographic map; it also closely approximates the postmining landscape under reclamation scenario 1. Diagram B represents the postmining condition under reclamation scenario 3.


A. Premining and Scenario 1

B. Scenario 3

Figure IV-4.--Rose plots showing prevailing wind direction as well as mean gradients and aspects of hillslopes in the premining and a postmining landscape in T. 19 N., R. 90 W., sec. 5 and in T. 20 N., R. 90 W., sec. 33. Diagram A represents the premining condition taken from a 7.5-minute USGS topographic map; it also closely approximates the postmining condition under reclamation scenario 1. Diagram B represents the postmining condition under reclamation scenario 3.

(very closely approximated by reclamation scenario 1) and a postmining (reclamation scenario 3) landscape. The rose plots do not have values at all aspects, since several classes did not contain any samples. The secondary peaks on the aspect frequency plots (fig. IV-3) represent the secondary ridges and escarpment slopes. This is further emphasized in figure IV-5, a plot of hillslope gradient frequency. The figure also illustrates the reduction in the number of high gradient slopes in reclamation scenario 3. Table IV-4 summarizes the hillslope gradient and orientation analysis.

The low frequency values of the secondary ridges and escarpment slopes indicate that a small portion of the total area has these orientations. While the frequency of these aspects is low, they appear to perform a vital function in creating the diverse microclimatic regimes important to vegetative and faunal habitat. Topographic elements combine with snow fall, prevailing wind direction, and sun orientation to determine microclimate. During the winter, prevailing wind direction is from the southwest to west and averages 13 to 24 miles per hour (Irwin and others, 1983). The winter winds have been noted to blow snow clear of main hogback ridges, as well as from secondary ridges. Snow collects in the lee of these features. The leeside slopes will generally be northeast facing and do not receive direct sunlight. Detailed information is not available to determine how significant the channels are to snow accumulation, overall snow hydrology, and soil moisture of the petition area.

The model presented in the petition, namely, that topographic elements determine the spatial distribution of snow accumulation, is reasonable. However, this model raises a question as to whether or not it is necessary to orient the ridges in the way they exist to create a similar set of microclimatic regimes. It is possible that a set of ridges with their long axes oriented northwest-southeast will collect snow on their lee slopes, have their crests blown clear of snow, and essentially provide the diversity of the existing landscape. This scheme, if viable, would have the advantage of allowing lower hillslope gradients, because of the more efficient orientation.

Frickel and others (1981) found that snow is the primary source of soil moisture in the Red Rim area, providing about 40 percent of the moisture. They found a relationship between the accumulation of snow, snowmelt runoff, moisture characteristics of the soil, and plant communities. Under any reclamation scenario, it would be necessary to take into consideration that certain soils (type and depth) should be placed where they would be exposed to a moisture source, such as snowmelt or overland runoff, in order to provide an adequate moisture reservoir for the plant community to be reestablished on that soil.

At Red Rim, the snow accumulation distribution is dependent on the aerodynamic "roughness" of the landscape. The U.S. Army Corps of Engineers (1956) found several general relationships of snow accumulation to topographic factors for a single snow course survey. They found an increase of 1 to 2.5 inches (water equivalent) for each 100 feet of elevation gain, a 0.2- to 0.5-inch decrease for each 1-percent increase in hillslope gradient, a 0.25- to 1.0-inch increase for each 10° deviation of hillslope aspect from south facing, and a 0.5- to 0.7-inch decrease for each 10° increase in the sum of arcs of exposure with no higher elevation within 0.5 miles (called exposure sector) for a single snow course survey. Analyses such as these and snow-deposition models that take into account topography and wind direction (Tabler, 1975a, 1975b) are useful for estimating the quantitative effects of topographic diversity. It is important to establish the

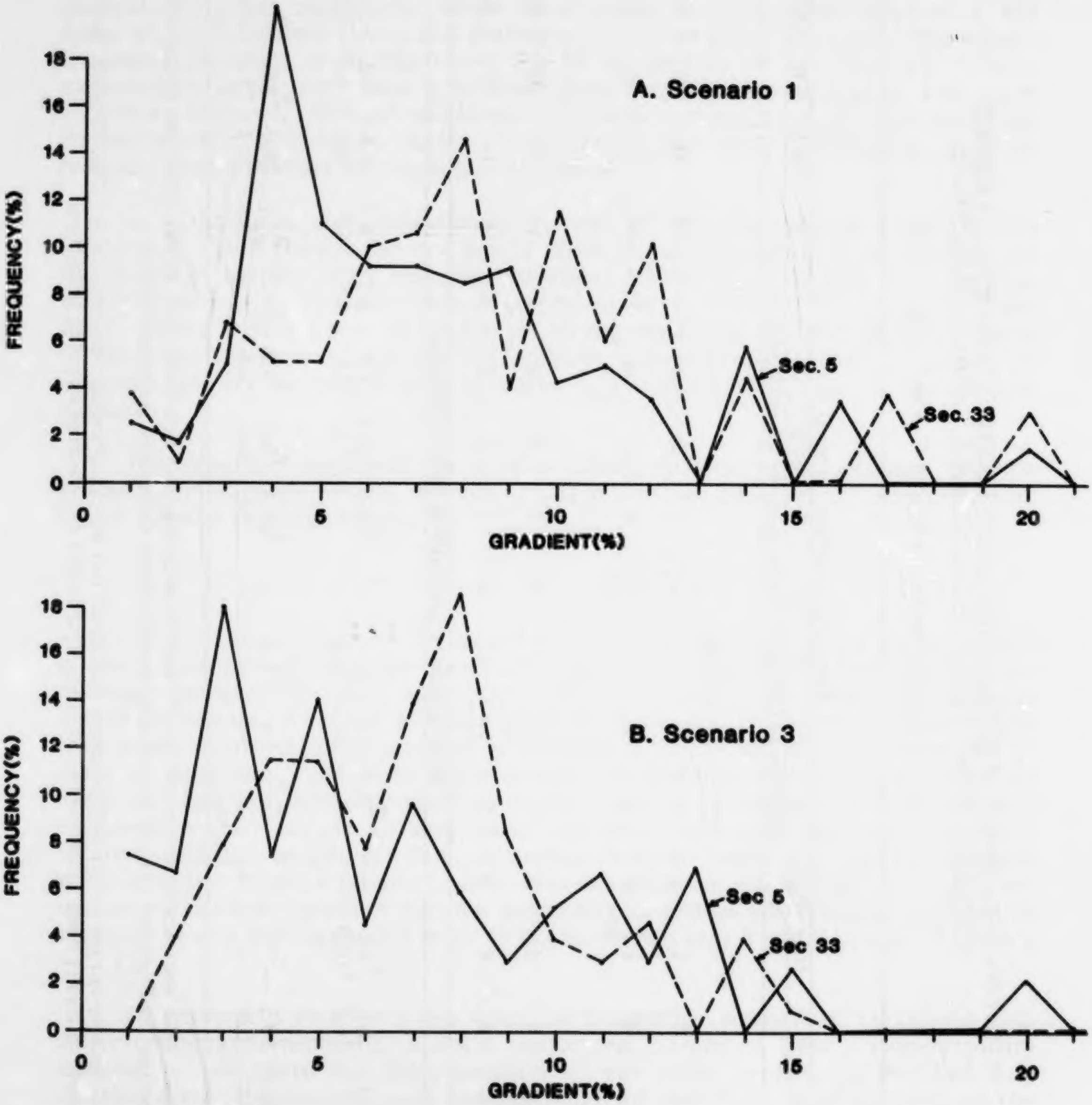


Figure IV-5.--Frequency plots of the hillslope gradient for a postmining landscape in T. 19 N., R. 90 W., sec. 5 and in T. 20 N., R. 90 W., sec. 33. Diagram A represents the premining condition; it also approximates the reclamation scenario 1 postmining landscape; diagram B represents the reclamation scenario 3 postmining landscape.

Table IV-4.--Number of hillslopes facing a given compass direction and mean gradients of those hillslopes, T. 19 N., R. 90 W., sec. 5, and T. 20 N., R. 90 W., sec. 33

(Data are summarized in figures IV-3 and IV-4)

	Compass direction (aspect)																Total number of hillslopes observed
	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	
Number of hillslopes facing each of these directions																	
Sec. 5:																	
Premining frequency	7	4	1	0	3	5	0	1	1	3	6	6	19	28	23	16	123
Postmining frequency	0	3	1	0	0	1	5	0	0	1	6	11	14	31	51	9	133
Sec. 33:																	
Premining frequency	12	6	1	1	2	4	5	0	7	7	2	7	12	26	38	21	151
Postmining frequency	4	6	0	0	0	0	0	0	1	4	7	4	9	14	67	16	132
Mean gradient (percent) of these hillslopes																	
Sec. 5:																	
Premining	6.4	5.4	[1]5.8	--	[1, 2]4.2	6.1	--	--[1]	[1]14.1	[1]15.1	8.2	5.2	[2]8.2	7.1	7.0	7.9	
Postmining	--	[1]4.1	[1]10.9	--	--	[1]14.1	[2]7.3	--	--	[1]2	7.4	6.8	6.7	[2]5.4	[2]6.9	6.2	
Sec. 33:																	
Premining	[2]10.5	[2]9.1	--[1, 2]	--[1, 2]	--[1, 2]	7.4	[2]8.4	--	[2]10.1	[2]8.2	[1]4.8	[2]6.2	[2]6.5	[2]8.0	[2]10.7	[2]8.7	
Postmining	7.0	6.0	--	--	--	--	--	--	[1]2.8	4.0	5.2	[2]5.0	[2]3.9	[2]6.2	[2]8.0	7.6	

[1] Because these data were collected by means of random sampling, too few (less than three) hillslopes facing this direction were sampled in this section to determine whether or not the mean gradient calculated is representative.

[2] Some or all random-sample points fell on areas that could not be classified as hillslopes on a 1:24,000-scale map (e.g., reservoirs, saddles, low-gradient valleys); these points were not used to calculate the mean gradient of hillslopes.

relative significance of each of these (and possibly other) topographic factors to provide guidance for reclamation.

Topographically, reclamation scenario 3 consists of a much less diverse landscape than currently exists or is proposed in reclamation scenario 1. In general, the gross topography would be emulated in reclamation scenario 3, but many of the secondary ridges and drainages would not be constructed. The aspect frequency plot (fig. IV-3) illustrates this by the lack of secondary peaks. This is expected to significantly reduce the local snow accumulation associated with these secondary features. Without sufficient local snow accumulation, it is unlikely that the snowmelt/soil moisture regime, important to the biotic community, could be restored even with careful placement of topsoil.

In addition to the reduction in number of secondary ridges, reclamation scenario 3 would reduce the number of channels, as indicated by the decrease of the drainage density from existing conditions (table IV-5). Table IV-5 contains values of several geomorphic factors computed for T. 19 N., R. 90 W., sec. 5, and for T. 20 N., R 90 W., sec. 33 for the premining condition, which closely resembles reclamation scenario 1, and for reclamation scenario 3. In both sections, the drainage density in reclamation scenario 3 is much lower than in reclamation scenario 1.

The drainage density of an area is closely related to the average hillslope gradient and hillslope length. Horton (1932) derived an equation for mean hillslope length ($\bar{L}$) of a drainage basin:

$$\bar{L} = \frac{1}{2D\,(1-r^2)^{1/2}}$$

where D is drainage density in miles per mi^2 and r is the ratio of the mean channel gradient (percent) to the mean basin hillslope gradient (percent). Therefore, as the drainage density increases, all other factors remaining constant, the hillslope length decreases. As mean hillslope gradient increases, the mean hillslope length decreases. Both hillslope gradient and hillslope length are important factors in rates of sediment yield from basin slopes. In addition, hillslope gradient is an important factor in landslide stability of the hillslope. Therefore, it is vital that a reclamation plan include an analysis of sediment yield and mass stability which balances hillslope length, gradient, and other factors. Table IV-5 also contains the value of mean hillslope gradient, mean channel gradient, mean hillslope length, and maximum hillslope gradient for the premining condition (essentially reclamation scenario 1) and for scenario 3 in T. 19 N., R. 90 W., sec. 5 and T. 20 N., R. 90 W., sec. 33.

To determine whether there would be a landslide problem on reclaimed spoil under reclamation scenario 1, OSM performed simplified Bishop slope-stability analyses to calculate the mass stability of two slope profiles in the Red Rim petition area. Because no spoil samples exist for Red Rim, OSM determined the mass-stability properties of spoil, upon which to base their slope analyses, from data contained in the permit application for Arch Mineral Corporation's Medicine Bow mine west of Hanna, Wyoming. OSM considered these data to be applicable to a mass-stability analysis at Red Rim because a mine at Red Rim would be located within the geologic formation that is currently being mined at the Medicine Bow mine. The data from which mass-stability properties of spoil were determined are:

Table IV-5.--Comparison of geomorphic characteristics computed on T. 19 N., R. 90 W., sec. 5 and T. 20 N., R. 90 W., secs. 33 and 34 for the premining condition (essentially reclamation scenario 1) and reclamation scenario 3

Location	Scenario	Sg[1] (percent)	Smax[2] (percent)	Sc[3] (percent)	D[4] (miles/ mi^2)	$\bar{L}$[5]	SY[6] (tons/ acre)	SY10[7] (tons/ acre)
sec. 5	1	11.3	100	4.9	19.4	151	---	---
sec. 5	3	7.4	22	5.7	3.0	1,380	---	---
sec. 33	1	10.5	56	3.5	23.0	122	---	---
sec. 33	3	7.0	20	3.7	3.1	1,005	---	---
sec. 34	([8])	---	---	---	---	---	.11	.10
sec. 34	3	---	---	---	---	---	.13	.12

---

[1] Sg = mean hillslope gradient computed by the line intercept method (Horton, 1932).

[2] Smax = maximum gradient found on USGS 7.5-minute quadrangle.

[3] Sc = mean channel gradient computed as the highest elevation minus the lowest elevation along the major drainage in the section divided by the channel length times 100.

[4] D = drainage density, which is the total length of channels (in miles) divided by the drainage area (in mi^2).

[5] $\bar{L}$ = mean hillslope length computed by the equation

$$\bar{L} = \frac{1}{2D\,(1-r^2)^{1/2}}$$

where

$$r = \frac{Sc}{Sg}.$$

[6] SY = sediment yield computed using the universal soil loss equation for selected slopes in sec. 34 (Frickel and others, 1981).

[7] SY10 = sediment yield computed using the universal soil loss equation for the 10-year, 24-hour storm for selected slopes in sec. 34 (Frickel and others, 1981).

[8] Sediment yields from reclamation scenario 1 are not available. These yields are natural condition.

soil density = 95.8 pounds per cubic foot; angle of internal friction = 35°; and cohesion = 120 pounds per square foot.

OSM performed its analysis on a slope profile that was delineated in the preliminary mining plan for the Red Rim tract (D. H. Emling Company, 1978). This profile of a portion of sec. 26, T. 21 N., R. 89 W. transects seams G and H where some of the most diverse topography on the petition area is located. The steepest hillslope measured from this profile was 31.3 percent. Under unsaturated conditions, OSM calculated the factor of safety for this 31.3-percent gradient to be 3.19; under saturated conditions, which would occur with heavy snow accumulation and melt, the factor of safety would be 1.47. (Wyoming DEQ regulations (Chapter IV, Section 3a(8)(C)) require restored slopes to have a factor of safety equaling 1.3 or greater. Slopes with a factor of safety less than 1.3 may not remain stable over the long term.) Therefore, the preliminary analysis for this slope profile indicates that slopes reclaimed to their premining gradient of 31.3 percent or less should not encounter mass-stability problems.

Hillslopes with gradients greater than 31.3 percent exist in or near the petition area. In the absence of detailed sections or topographic maps showing these steeper slopes, OSM estimated hillslope gradients and developed a hypothetical profile based on a photograph taken of an escarpment in sec. 8, T. 19 N., R. 90 W. OSM determined that the gradient of the escarpment was approximately 70 percent. Under saturated conditions, the factor of safety was calculated to be 1.19; under saturated conditions, the factor of safety was calculated to be 0.21. Therefore, without any structural means of stabilization, a reconstructed hillslope of 70-percent gradient would not meet Wyoming DEQ standards; the long-term stability of such a slope would not be ensured.

Based on these preliminary analyses, saturated slopes greater than 32 percent could be subject to landsliding and would not meet Wyoming DEQ regulations for a minimum factor of static safety. Given that slopes in excess of 32 percent exist on Red Rim, it would not be possible to restore the entire Red Rim landform to the stable premining condition over the long term. Structural controls or special handling and selection of spoil materials could mitigate landsliding of slopes steeper than 32 percent.

Under reclamation scenario 1, mined areas on Red Rim would be reclaimed to hillslopes with gradients of less than 32 percent. These slopes would be stable and so not subject to landslides. However, a small percentage of hillslopes, located adjacent to draws, now exceed gradients of 32 percent. As stated, these slopes could probably not be reclaimed without structural controls over the long term. On the other hand, it seems unlikely that these draws would have to be reclaimed to sideslope gradients of greater than 32 percent to accumulate snow, although this has not been conclusively demonstrated. The reclamation scenario 3 landscape would not contain any hillslopes with gradients in excess of 32 percent, based on D. H. Emling Company maps (1978).

A factor possibly limiting reclamation success is upland and channel erosion. Upland and channel erosion are dependent on, among other factors, the topographic character. Upland erosion instability will be reflected in excessive rilling and gullying, and fans deposited at the foot of slopes. Upland sediment yields were calculated using the universal soil loss equation for average factor values from selected hillslopes in T. 20 N., R. 90 W., sec. 34 for reclamation scenario 3 and for natural conditions by Frickel and others (1981; table IV-5). They computed an increase in sediment yield of 18 percent over the existing conditions for a scenario 3 hillslope. This computation included an assumed control practice of contour furrowing on steep slopes. Sediment yields are not available for reclamation scenario 1 conditions, but it is assumed that sediment yield would be much greater than for natural conditions and somewhat greater than for reclamation scenario 3. Hillslope shape can have an important impact on sediment yeild. Reconstructing hillslopes with concave profiles can reduce sediment yield by 26 perccent from a convex profile and 13 percent for a uniform profile (Barfield and others, 1981). Reconstructing hillslopes with complex profiles (i.e., convex at the top of the hillslope, uniform at midslope, and concave at the bottom of the hillslope) may reduce sediment yield even more.

Channel stability is related to several factors, foremost of which is channel geometry and peak discharge. As stated above, it is not known what channel and valley geometries are needed to provide snow accumulation adequate for support of the desired biotic communities. Channels with less gullylike configurations than now exist could accomplish this function. Frickel and others (1981) computed a 20-percent increase in the 10-year peak flow in reclamation scenario 3 over existing conditions. It is not known what effect this will have on channel stability. There is no information available for reclamation scenario 1 flow conditions.

An analysis using computer assisted design techniques was performed by OSM to visually compare the topography of the petition area before and after mining. This analysis was based in part on information supplied by RME in its preliminary mining plan (D. H. Emling Company, 1978). The analysis was performed for T. 19 N., R. 90 W., sec. 5 and T. 20 N., R. 90 W., sec. 33. As with the preceding topography analyses, these sections were chosen for analysis because they are located within the pronghorn critical winter range, contain many diverse topographic features, and were proposed to be mined under the preliminary mining plan.

Figures IV-6 and IV-7 show the premining topography of the two sections, and figures IV-8 and IV-9 show the postmining topography based on RME's preliminary mining plan (D. H. Emling Company, 1978). These figures, in conjunction with three-dimensional perspective views of premining and the preliminary plan post-mining topography (figs. IV-10 and IV-11), show that the preliminary plan post-mining topography will be less complex than the premining topography. Selected blowups of these three dimensional perspective views are shown in figures IV-12, IV-13, and IV-14. These figures clearly indicate that, under the preliminary mining plan (in essence, reclamation scenario 3), the small swales and draws that provide shelter to the pronghorn and increased moisture to the vegetation would be lost after reclamation. This change in topography is better quantified in figures IV-15 and IV-16, which show the extent the land surface would be lowered as a result of mining. This reduction in elevation would be greatest in those areas where the small hills and ridges would be mined through.

OSM's analysis shows that the gradient of most slopes in the petition area is less than 32 percent; these slopes could be reclaimed to a standard safety factor of 1.47. Although slopes with gradients greater than 32 percent could not be safely restored, given the preponderance of less steep slopes in the petition area, OSM believes that the majority of reclaimed slopes would provide forage to pronghorn.

Page 12, footnote 25, at bottom of page, states:

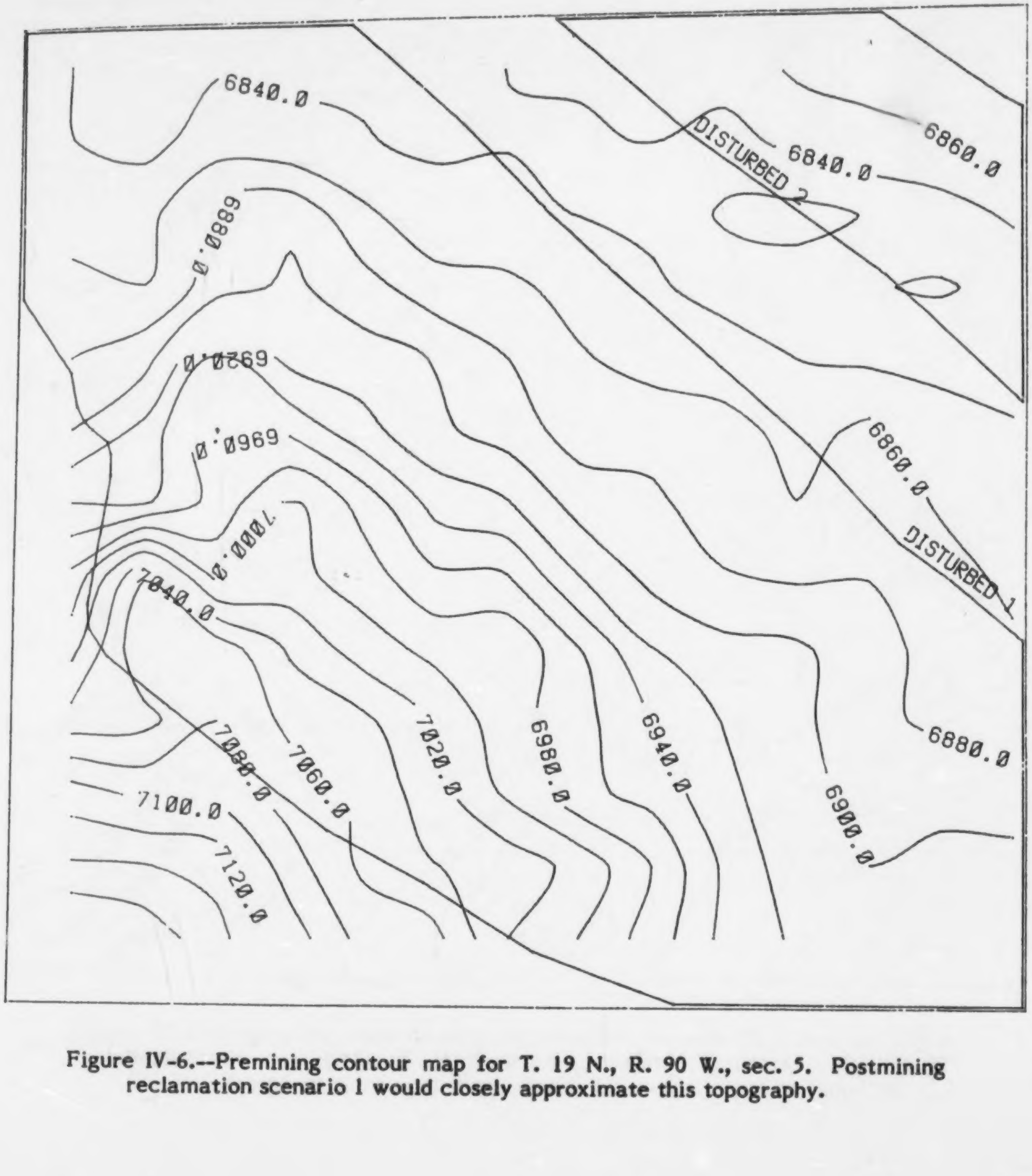

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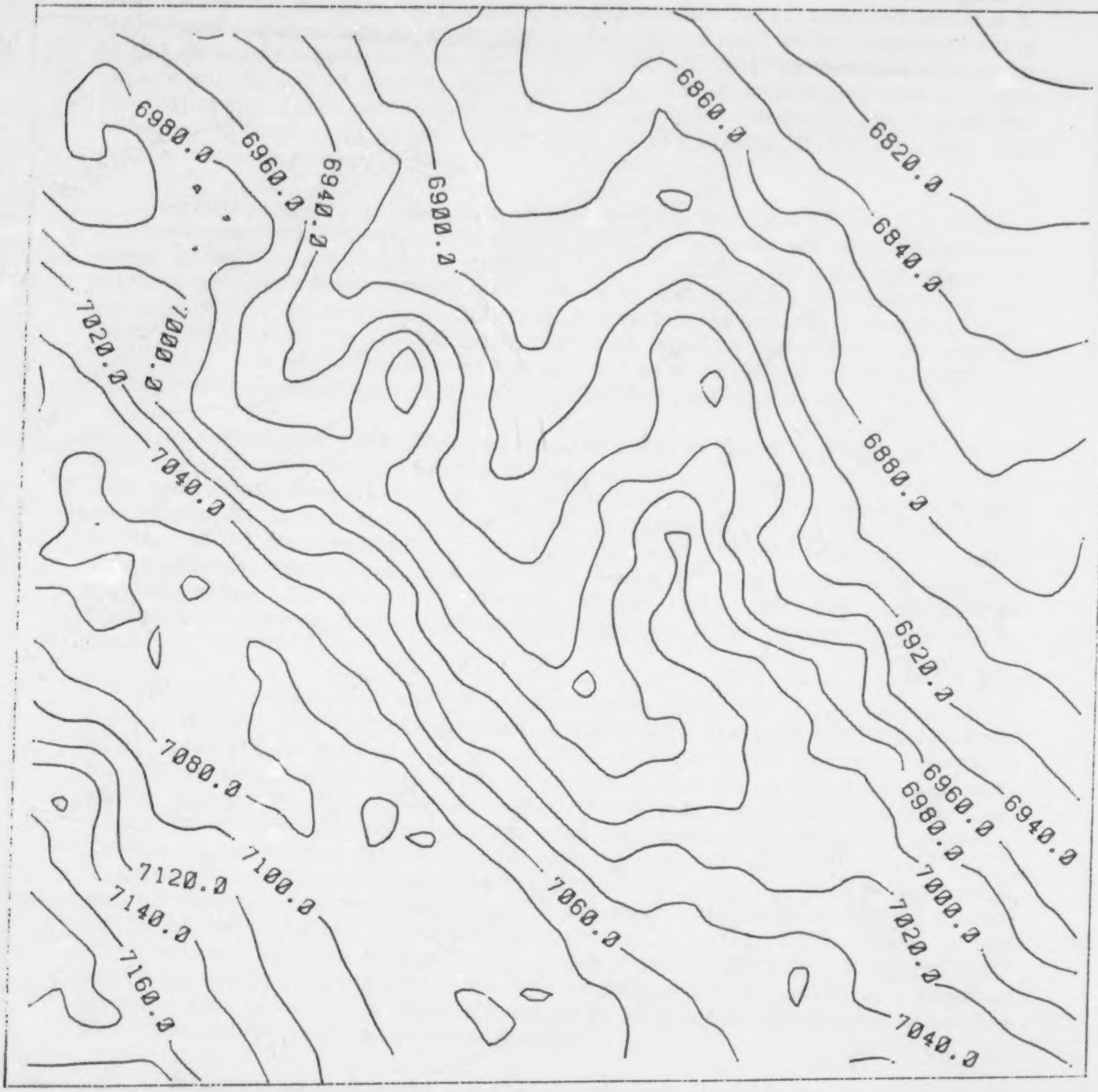
Figure IV-6.--Premining contour map for T. 19 N., R. 90 W., sec. 5. Postmining reclamation scenario 1 would closely approximate this topography.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7020.0
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Figure IV-7.--Premining contour map for T. 20 N., R. 90 W., sec. 33. Postmining reclamation scenario 1 would closely approximate this topography.

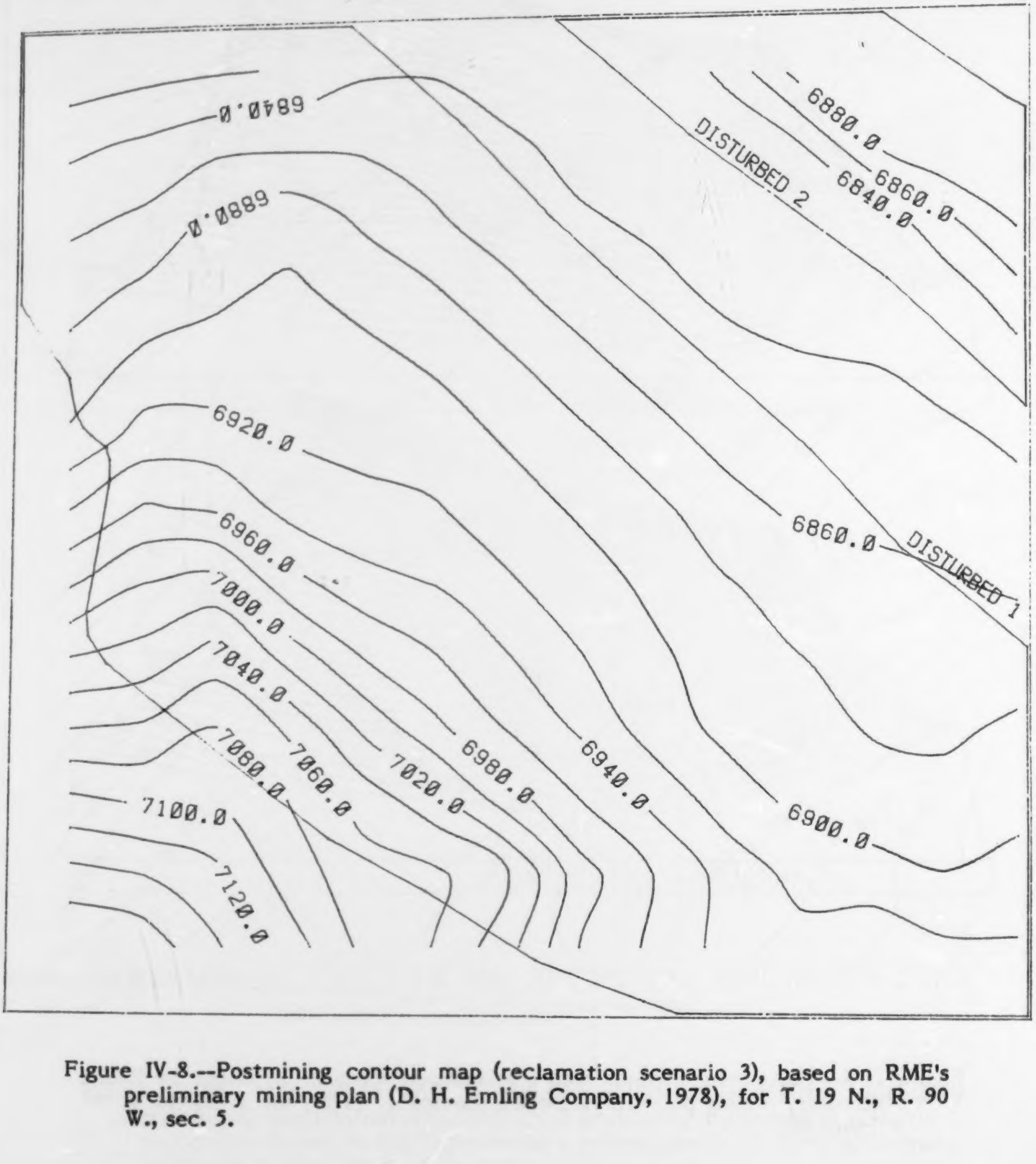
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Figure IV-8.--Postmining contour map (reclamation scenario 3), based on RME's preliminary mining plan (D. H. Emling Company, 1978), for T. 19 N., R. 90 W., sec. 5.

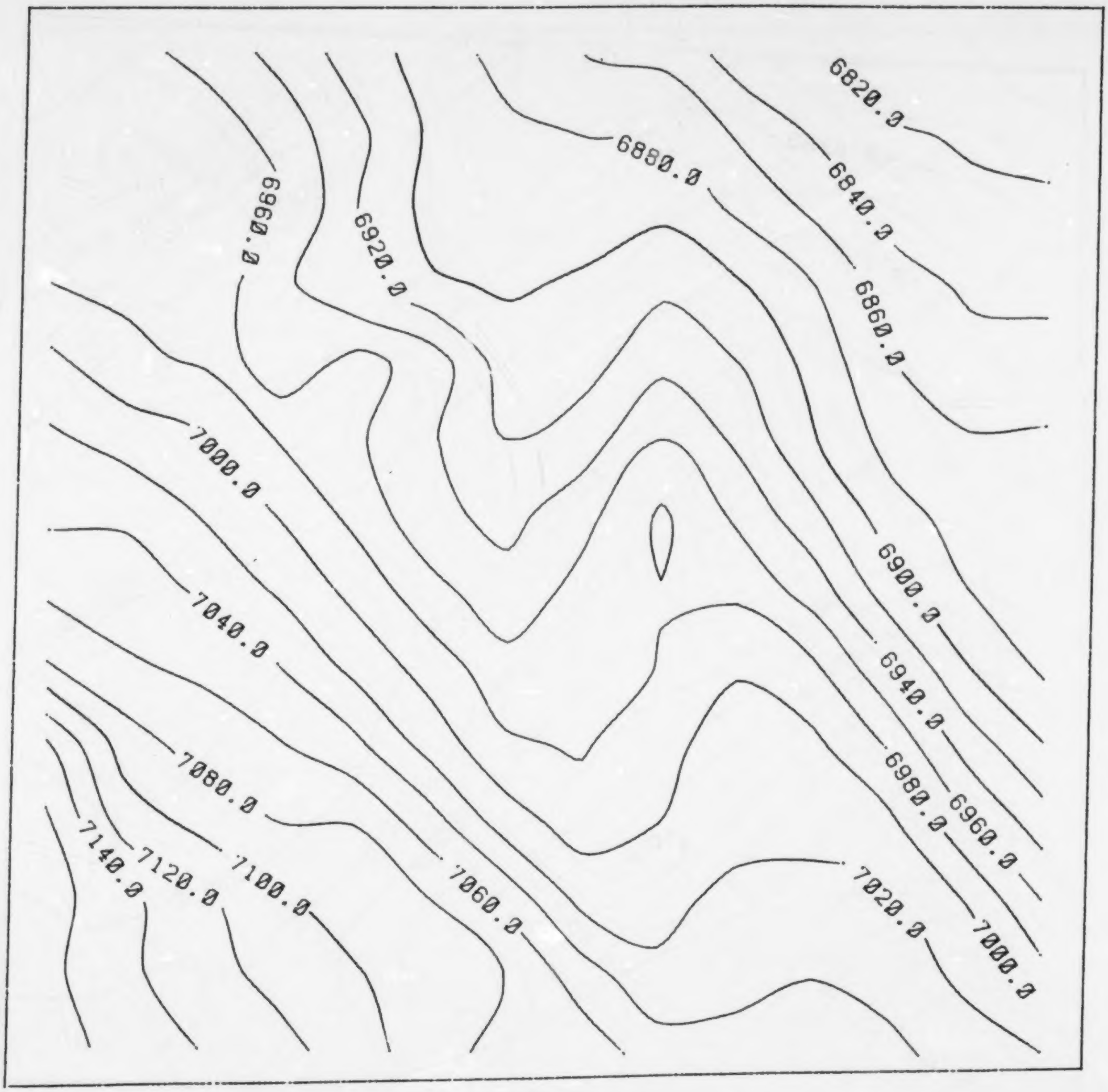
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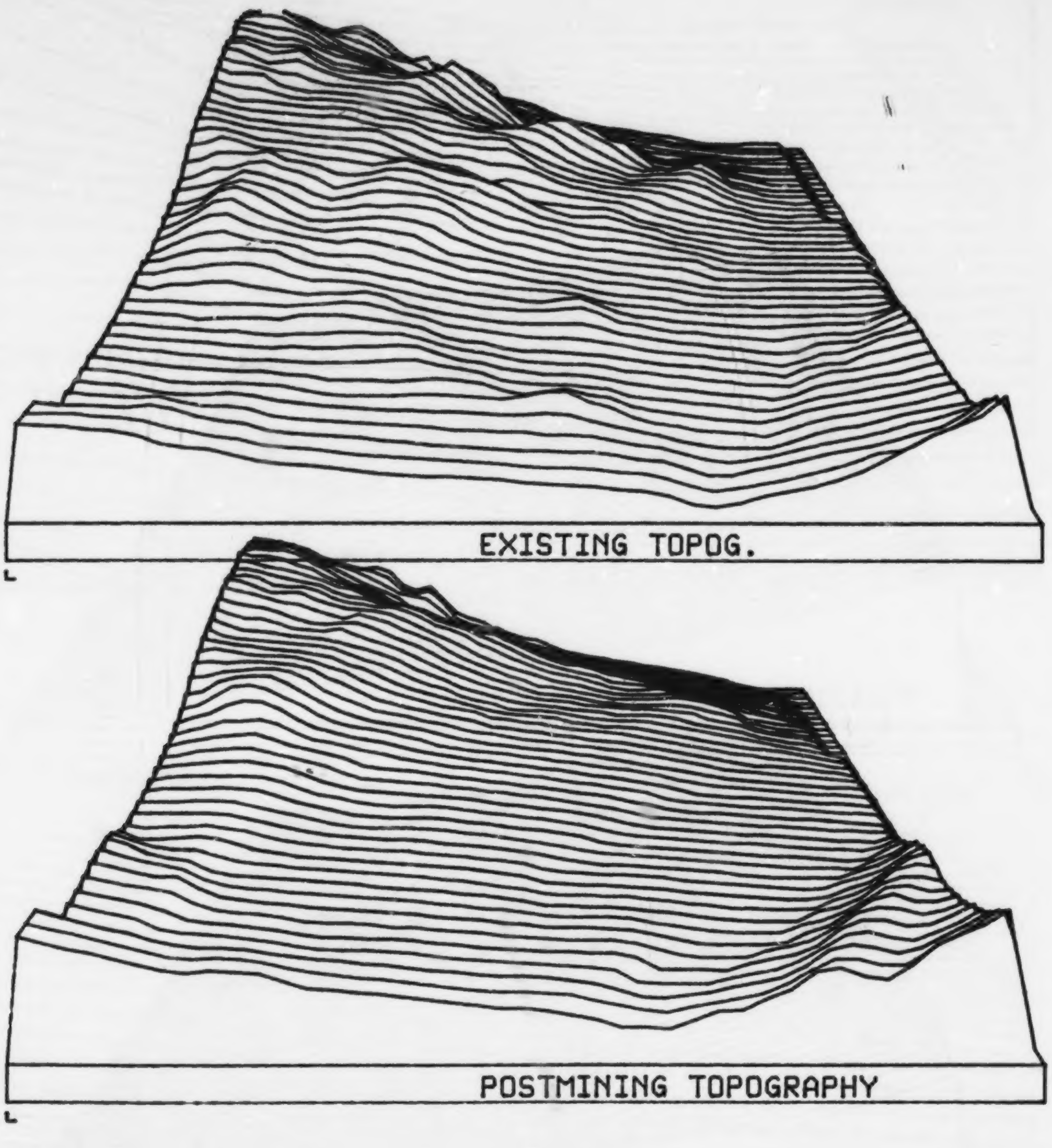
Figure IV-9.--Postmining contour map (reclamation scenario 3), based on RME's preliminary mining plan (D. H. Emling Company, 1978), for T. 20 N., R. 90 W., sec. 33.


EXISTING TOPOG.
POSTMINING TOPOGRAPHY

COMPARISON OF EXISTING AND POSTMINING TOPOGRAPHY SEC.5
Vertical Exageration = 5X

Figure IV-10.--Three-dimensional perspective views of premining (essentially postmining reclamation scenario 1) and postmining (reclamation scenario 3) topography (based on RME's preliminary mining plan (D. H. Emling Company, 1978)) for T. 19 N., R. 90 W., sec. 5.

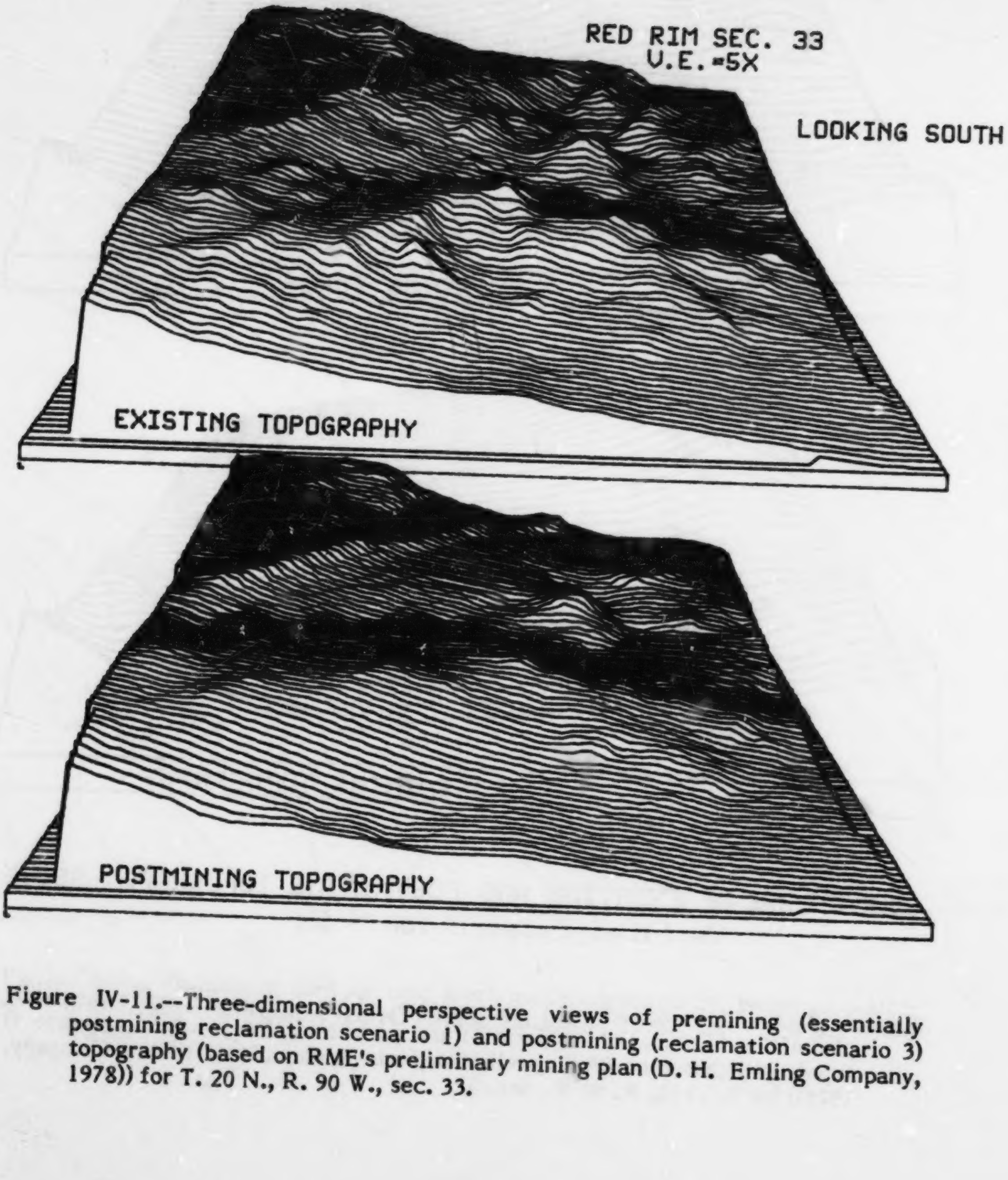
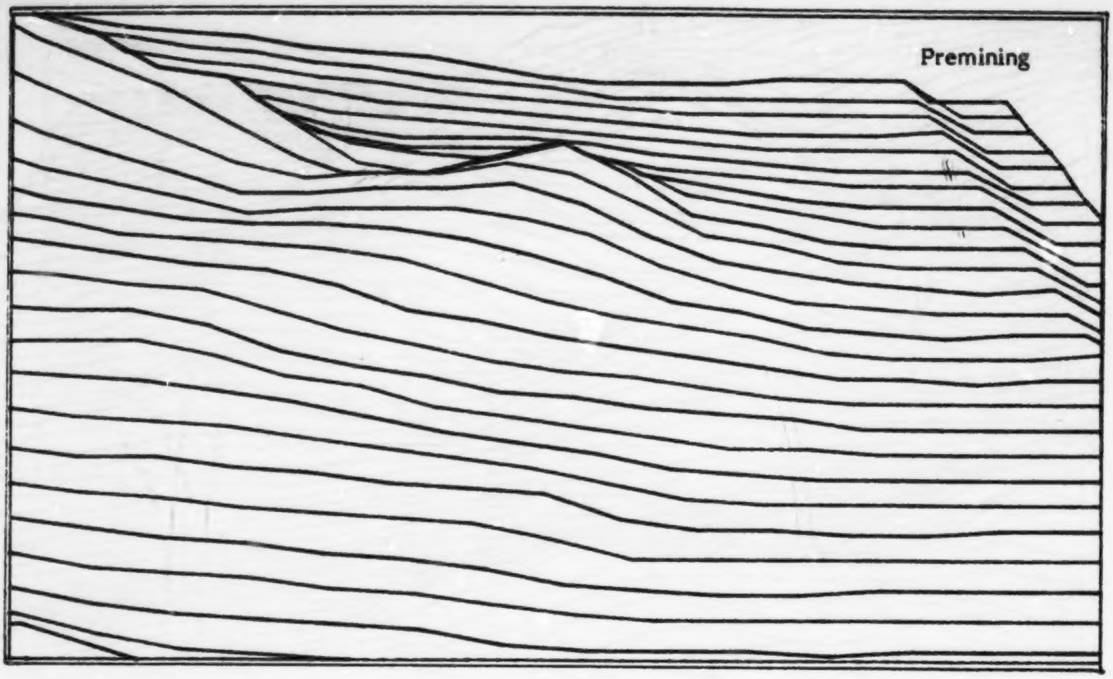

RED RIM SEC. 33
V.E.=5X
LOOKING SOUTH
EXISTING TOPOGRAPHY
POSTMINING TOPOGRAPHY

Figure IV-11.--Three-dimensional perspective views of premining (essentially postmining reclamation scenario 1) and postmining (reclamation scenario 3) topography (based on RME's preliminary mining plan (D. H. Emling Company, 1978)) for T. 20 N., R. 90 W., sec. 33.



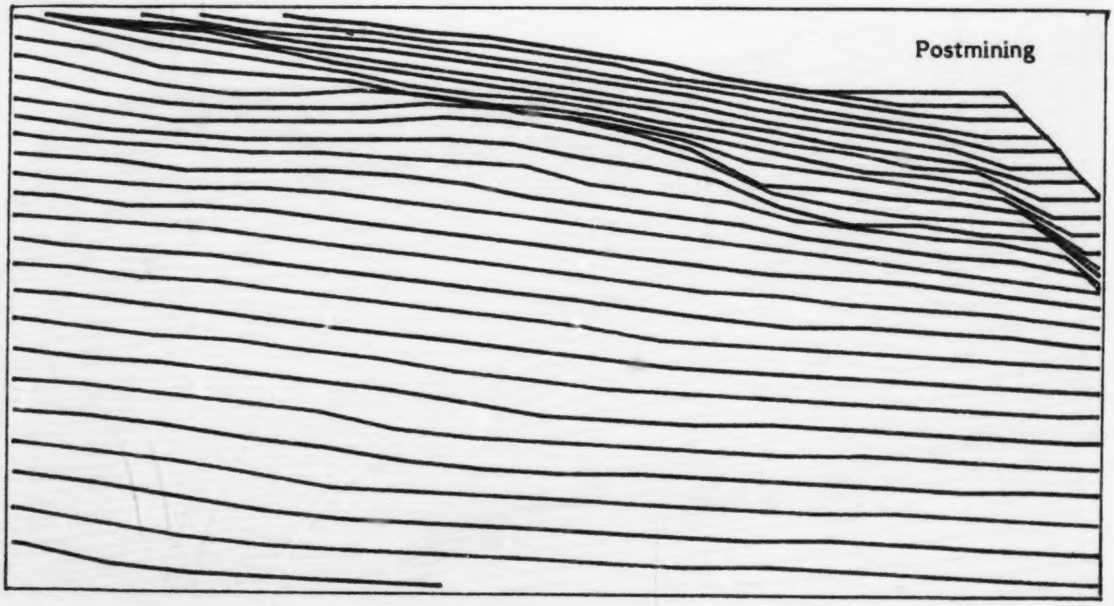

Postmining

Figure IV-12.--Portion of T. 19 N., R. 90 W., sec. 5, showing difference between premining (essentially postmining reclamation scenario 1) and postmining (reclamation scenario 3) topography.

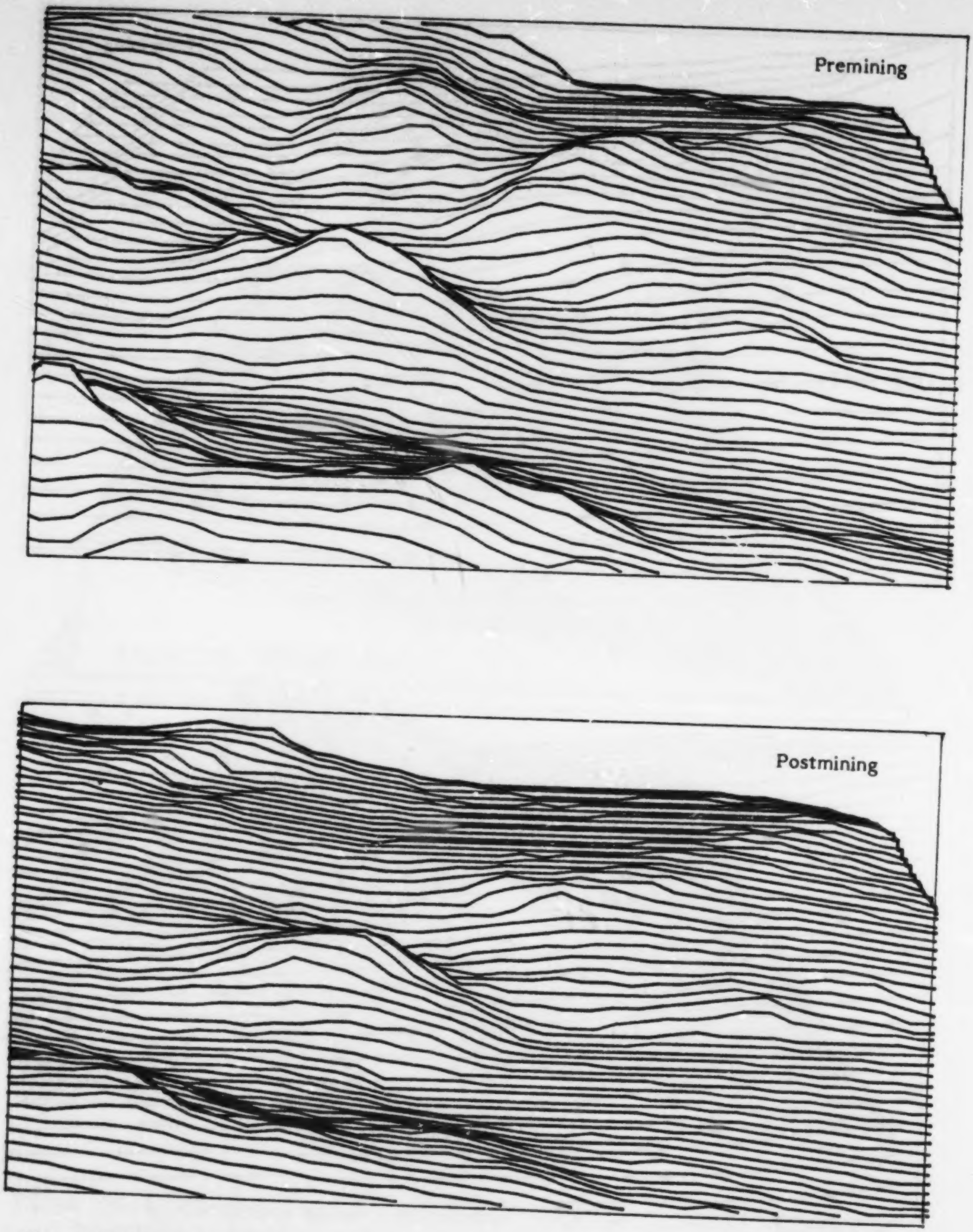

Premining
Postmining

Figure IV-13.--Portion of T. 20 N., R. 90 W., sec. 33, showing difference between premining (essentially postmining reclamation scenario 1) and postmining (reclamation scenario 3) topography.

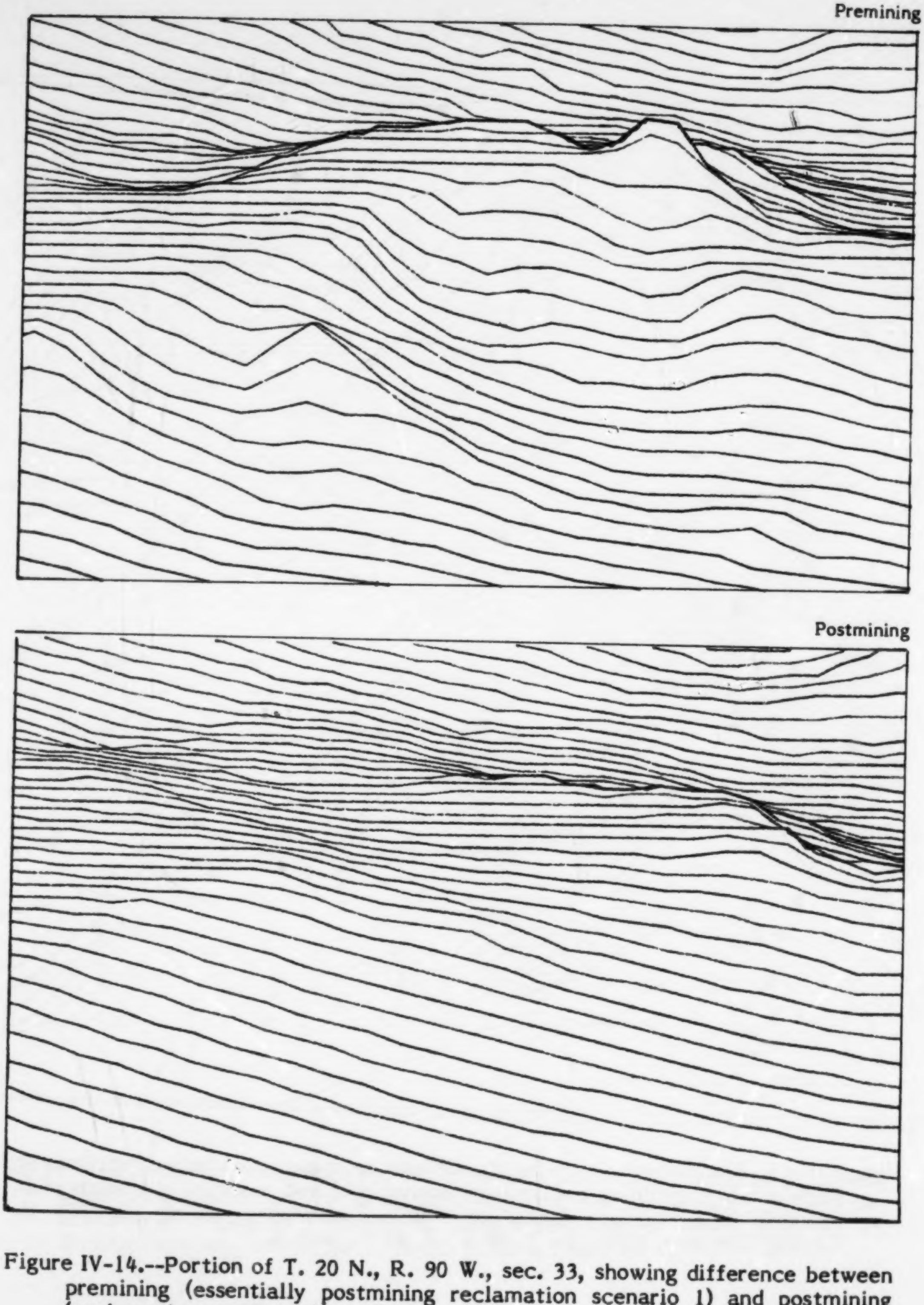

Premining
Postmining

Figure IV-14.--Portion of T. 20 N., R. 90 W., sec. 33, showing difference between premining (essentially postmining reclamation scenario 1) and postmining (reclamation scenario 3) topography.

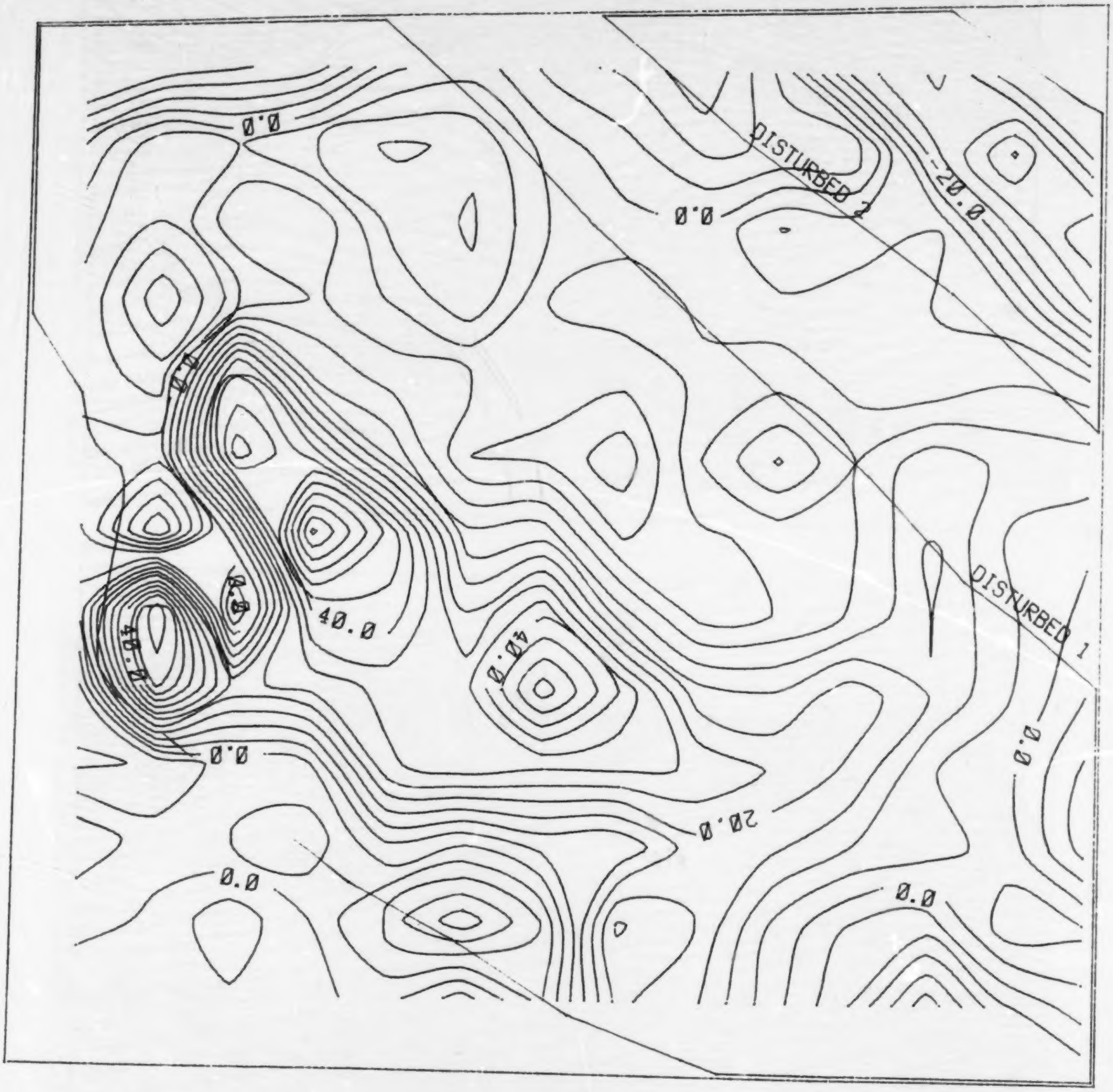

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Figure IV-15.--Contour map showing the difference in elevation between premining (essentially postmining reclamation scenario 1) and postmining (reclamation scenario 3) topography (based on RME's preliminary mining plan (D. H. Emling Company, 1978)) for T. 19 N., R. 90 W., sec. 5.

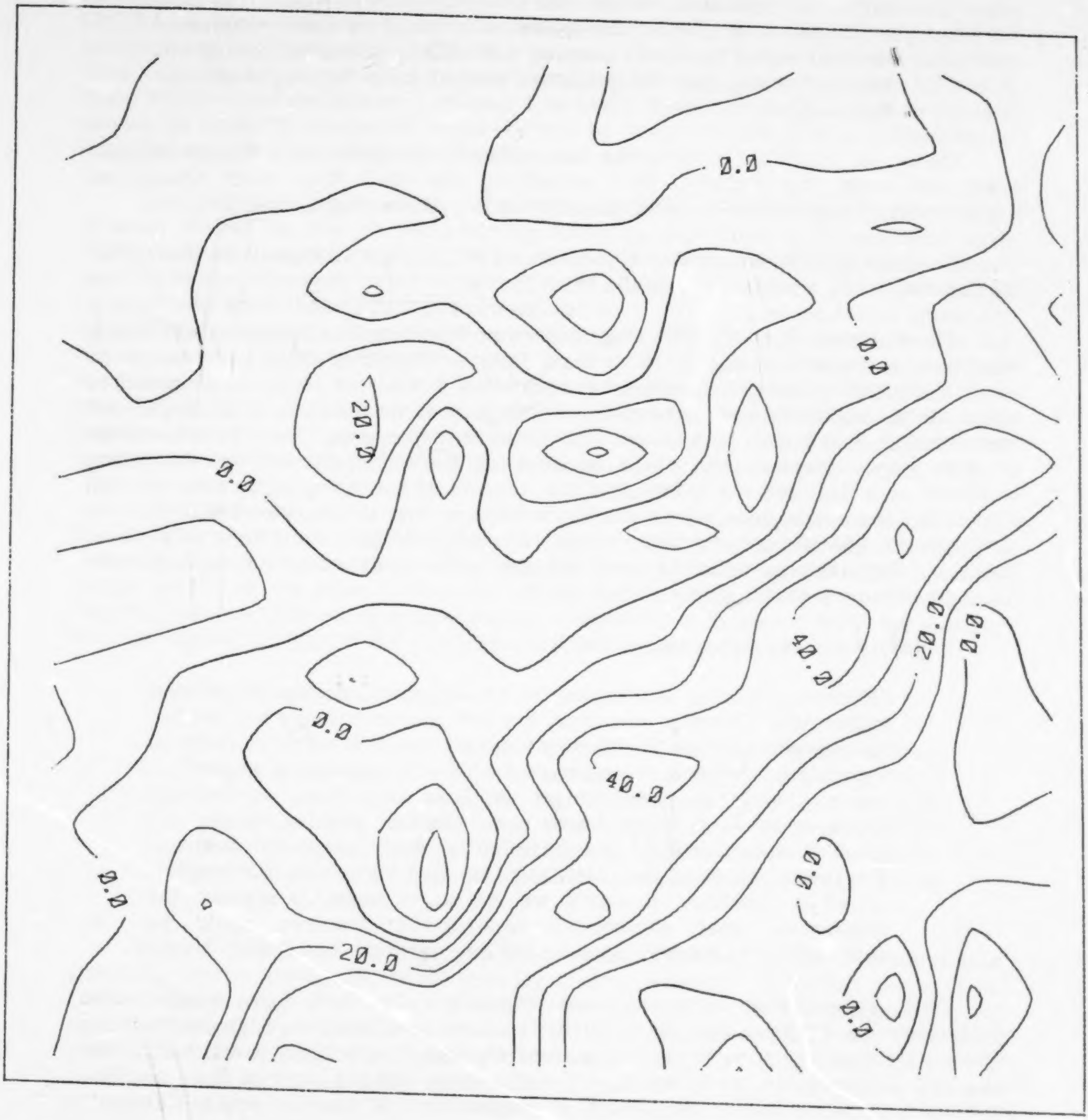
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Figure IV-16.--Contour map showing the difference in elevation between premining (essentially postmining reclamation scenario 1) and postmining (reclamation scenario 3) topography (based on RME's preliminary mining plan (D. H. Emling Company, 1978)) for T. 20 N., R. 90 W., sec. 33.

> "[25] RME reportedly has no plans to undertake a post-mining program of micro-contouring due to the difficulty of recontouring with unconsolidated material in an arid, windy climate. Further, reclamation of the small draws so critical to the pronghorns' survival would not be in keeping with EQC's purported policy not to approve any plan for reclamation that calls for slopes greater than 3:1."

Owing to its affiliation with the Union Pacific Corporation, RME can neither lease nor mine the Federal coal underlying the Red Rim tract (based on Department of Interior Solicitor's Opinion M-36945, December 6, 1982).

The reestablishment of the topographic features are discussed in the reclamation scenario 1 section of appendix F.

There are no Wyoming DEQ regulations or Wyoming EQC policies restricting maximum reclaimed slopes to less than 3h:1v. Wyoming DEQ regulations do require that all available material be backfilled within pit limits and graded to eliminate all highwalls and depressions. As long as demonstration of erosional and mass stability has been made, slopes may be of any steepness. Very few operators propose slopes greater than 3h:1v because of the difficulty of demonstrating erosional stability, and the safety and cost factors of operating equipment on such slopes, but the option does exist. Maximum slope configuration is controlled by the language of Chapter IV, Section 3.a.(4), Wyoming DEQ, Land Quality Division, Rules and Regulations, which requires grading to the most moderate slope possible having a minimum static safety factor of 1.3.

Pages 11 and 12, paragraphs 4 and 1, state:

> "Micro-contouring attempted in reclamation of the large coal mines near Colstrip, Montana, has not proven entirely successful. Soil stabilization on the sloping sides of the draws continues to be a problem.[23] Because regeneration of soil-stabilizing vegetation would predictably take longer on Red Rim than at Colstrip (because of Red Rim's lower precipitation, greater winds, and lower temperatures),[24] it is anticipated that topographic restoration would be even less successful on Red Rim than that experienced at Colstrip. In short, we see no evidence to support the proposition that pre-mining topographic features could be successfully reestablished over the long term on Red Rim.[25]"

OSM agrees that environmental conditions at Red Rim would make reclamation of mined areas there difficult. Low precipitation, high, dessicating winds, high total moisture stress and moderately high conductivity levels within the soil, high soil osmotic pressures, highly sodic soils, and moderately fine- to fine-textured soils would hinder the growth of vegetation that would stabilize hillslopes against erosion.

OSM disagrees that microcontouring comparable to what would be attempted at Red Rim under reclamation scenario 1 is being or has been performed at Colstrip. ("Microcontouring" at Red Rim under this scenario would amount to spoil sculpturing on a large scale, so as to restore the area to a configuration closely approaching its premining configuration, not to gouging, pitting, or creating depressions on a small scale.) OSM assumes that the soil-stability problem the petitioners cite with reference to Colstrip exists at pit 6 of Western Energy Company's Rosebud mine. This pit was mined prior to the enactment of SMCRA; therefore, no requirement was made that it be reclaimed in accordance with SMCRA performance standards. In consequence, pit 6 spoil was not regraded to approximate original contour; for this reason, the long, steep slopes it comprises have been consistently subject to considerable gullying. Given the means by which these slopes were reclaimed, the extent to which their reclamation was successful cannot be usefully compared to the extent to which reclamation of hillslopes at Red Rim may be successful under reclamation scenario 1.

Any proposed approach to reclamation at Red Rim would be subjected to detailed review at the mine-permitting stage to determine its compliance with SMCRA and any more stringent BLM lease stipulations. Such a proposal would have to design hillslopes to meet current mass-stability standards; it would have to demonstrate that these hillslopes would not be subject to excessive erosion. If OSM were to require a permit applicant to reclaim Red Rim in accordance with the requirements of reclamation scenario 1, prior to being able to mine the area that applicant would have to show the feasibility of reclaiming steep hillslopes to a stable configuration. Should the applicant not show such feasibility, OSM could require that it use physical structures and/or erosional-control structures or methods to increase the structural and erosional stability of steep hillslopes.

OSM believes that it may not be necessary to microcontour mined areas at Red Rim so that their postmining closely approaches their premining topography. A detailed study of Red Rim's topography as it relates to pronghorn critical winter range needs has not been performed. Once such a study has been completed, it may be possible to identify a topographic configuration different from the existing one that would still fulfill the pronghorn critical winter range needs.

Page 12, paragraph 2, alleges:

> "Since critical winters occur unpredictably on the average of once every ten years, it would be essential to the herd that critical winter range be returned to optimum vegetative densities promptly after disturbance. A twenty to forty year restoration plan is unacceptable, as it would unavoidably result in (a) disastrous cumulative impacts, and (b) serious annual losses during critical winters."

Winter conditions vary from year to year, each having its own particular snowfall, temperature, and wind velocity characteristics. Although there is no strict definition of a "critical winter," Irwin and others (1984) assigned winter severity "scores" to the winters between 1971 and 1982 to compare the effects of those winters on pronghorn. The scores were determined by using variables such as maximum and minimum daily temperatures, number of days with temperatures below 32°F, days below 0°F, total snowfall, and greatest depth of snow. During the 11-year period, there were two winters with high severity scores. The winter of 1972-73 was by far the most severe, although the 1978-79 winter also ranked much higher than the others. Although not included in Irwin and others' study, the winter of 1983-84 is considered to have been more severe than any of the winters studied.

The existing shrub densities (see table, appendix F) are very high and probably cannot be achieved throughout the landscape, irrespective of cost. It is doubtful, however, that the density is as important as the amount and availability of forage. OSM acknowledges that amounts of shrub biomass equal to or greater than what is currently being produced should be available during critical winter months to sustain the current pronghorn herd. Reclamation under scenario 1 would concentrate on a modest reduction in the density of shrubs with an intent to increase individual plant vigor, resulting in comparable absolute cover values. The difficulties of prompt reestablishment have been addressed in responses to preceding allegations.

OSM's estimates of pronghorn mortality owing to mining are discussed in section IVB, in response to a previous allegation.

Page 12, paragraph 3, states:

> "Two potential methods have been suggested to accomplish restoration. One involves transplanting individual mature shrubs with a tree spade, combined with a seeding program to reestablish other components of the natural vegetative community. The second involves a program of 'dry-land sodding.' We find no evidence that either method is economically feasible to restore Red Rim as critical wildlife habitat for pronghorn within a reasonable time, i.e., before the first critical winter."

Page 14, paragraph 2, states:

> "Transplanting individual mature sagebrush plants with a tree spade at the current, pre-mining shrub densities on Red Rim *might* result in adequate revegetation of the critical wildlife habitat for a *short* period, i.e., until a few sequential years of precipitation at normal or below normal levels. Sagebrush densities on Red Rim are diverse, currently ranging from 800 plants to 7,700 plants per acre, with an average of about 4,000 plants per acre (almost ten times the transplant density achieved by RME on its test plots).[33] Although the difficulty in achieving plant proliferation might be avoided by this method, costs would be astronomical. *See* 'restoration costs,' below. Furthermore, without micro-contouring sufficient moisture would not be available to sustain pre-mining shrub densities over the long run.[34]"

Page 15, paragraph 1, states:

> "'Dry-land sodding' could be an effective method of revegetation. With this method individual 'pads,' i.e., sagebrush and sagebrush-grass types of vegetation already growing elsewhere on a parcel of soil measuring approximately 8-feet long by 5-feet wide by 1-foot deep, are uprooted and placed contiguously across the prepared post-mining surface (see 'topographic restoration,' above). Sagebrush transplanted in this manner are limited in height to about 6 inches. Larger plants would not survive because of damage to their tap roots in the initial uprooting and transport of the 1-foot-thick dry-land sodding pads. It would take at least another 15 years before transplanted 6-inch-high sagebrush plants would reach the height of sagebrush (15 inches to 5 feet) currently available to pronghorn on Red Rim.[35]"

A discussion of the premining and postmining densitites of sagebrush is included in the responses to the preceding allegation and in appendix F.

A tree spade and/or front-end loader are capable of successfully transplanting shrubs, including big sagebrush. The "dry-land sodding" technique is not generally acceptable for transplanting larger shrubs because of the shallow nature of the soil and plant materials being removed. None of the above methods are suited for reestablishing densities of 3,000 or more big sagebrush plants per acre on several hundred acres of reclaimed land.

RME has suggested and demonstrated the viability of transplanting, by means of tree spade, big sagebrush into areas of shallow disturbance. However, the exclusive use of the tree spade or related methods to achieve or approach the existing big sagebrush densities, as determined by RME's vegetation studies (Rocky Mountain Energy Company, 1982b; see appendix E), would be impractical from both the economic and the resource standpoints. The cost figures on the use of the tree spade and other portions of the revegetation work appear later in this chapter.

The impacts of transplanting big sagebrush using a tree spade could be considerable. It would be possible to obtain some plants in advance of the opened pit areas by directly transporting them to areas being reclaimed. However, in obtaining a minimum of 3,000 big sagebrush plants (assuming nearly 100-percent survival; see appendix F) per acre, there would be a need to transplant sagebrush from areas outside future mine areas. The offsite damage resulting from securing the total number of plants required would offset any beneficial impacts that might be achieved. Impacts would include opening of small pits, where the big sagebrush plant was removed, and exposing either bedrock materials, in the case of shallow soils, or deep subsoil materials (B, C, or R horizons), which may have little potential to produce forage.

OSM considers a planting program which utilizes sagebrush transplants, shrub tubelings, and a grass, forb, and shrub seed mix to be a more viable option. (The planting rates used in OSM's revegetation cost estimates are shown later in this chapter in tables IV-7 and IV-8.) Also, direct hauling of topsoil would increase the potential for additional reestablishment of big sagebrush (Kevin Allred, Native Plants, Inc., Salt Lake City, Utah, oral communication, 1983; Coenenberg (1982); Joe Coenenberg, Western Energy Company, Colstrip, Montana, oral communication, 1983; Howard and Samuel (1979)).

Page 13, paragraph 2 alleges:

> "RME's test plots were located on the most receptive of Red Rim's terrain, i.e., on a relatively level area with comparatively deep topsoil. These test plots were exposed to unusually favorable moisture conditions created by two extraordinarily wet springs. Further, the shrubs were transplanted into recently disturbed land with fresh topsoil, within minutes of the shrubs' removal from adjacent ground. Clearly, their survival fails to reflect the real obstacles to reclamation and fails to demonstrate adequately reclamation feasibility under normal conditions.[27]"

Page 13, paragraph 3, alleges:

> "In the absence of the numerous draws presently on Red Rim, restoration of the current diversity and density of vegetation would not be possible.[28] Even if successful, however, regeneration to current densities would be very slow, and aggravated by low annual precipitation,[29] averaging 9.5 inches per year."

RME (1982c) stated that the sagebrush transplant test plots were designed only to establish that the big sagebrush plants could be transplanted by this method. To be technically correct, one would have to add three additional restrictions to the RME statement, including:

a. Demonstration that plants of Artemisia tridentata (subspecies unknown) from the Red Rim population can be successfully transplanted by the methods used under the same climatic regimes present during the test.

b. That success was demonstrated only for this site--geology, topography/slope, soil--and for the type of treatments (including supplemental irrigation) which were applied.

c. That the test was conducted under simulated conditions of direct hauling of topsoil which would not be applicable to all reclaimed areas.

Pages 13 and 14, paragraphs 3 and 1, allege:

> "Under the best circumstances, it would not restore all of the land to its original vegetative quality in less than 20 years after cessation of the projected 25-year mine life, i.e., in less than 45 years total.[30] GFD doubts that original vegetative quality could be restored in less than 40 years after cessation of the projected 25-year mine life, i.e., in less than 65 years total.[31] By that time, the pronghorn life traditionally relying on Red Rim would have been extinguished.[32]"

OSM assumes that, by restoring "original vegetative quality," the petitioners mean reestablishing the vegetative characteristics of the critical winter pronghorn habitat. By using the much refined planning techniques and methodologies outlined in reclamation scenario 1, it may be possible to return the site to full production for critical pronghorn habitat within 10 to 12 years after planting. (See appendix F.) Lower than normal precipitation could result in partial or complete loss of this planted vegetation, and the revegetation effort would have to be started over.

Pronghorn life on Red Rim would not be extinguished by mining. As discussed in section IVB, the pronghorn herd relying on Red Rim may be reduced, not lost, if mining occurs.

Page 16, paragraphs 1, 2, 3, and 4, state:

> "Assuming RME will attempt micro-contouring, and success is possible on Red Rim, the estimated cost of restoration to simulate pre-mining drainage patterns ranges from $6,000 to $7,500 per acre. See Table 2, 'Topographic Restoration.'[36]"

> "RME reported costs of $15 per transplant on their test plots. At approximately 435 transplants per acre, their program would cost $6,424 per acre for restoration of the vegetation. See Table 2, "Program" 1. a.
>
> "At $25 to $70 per transplant, which are figures cited by other experts,[37] and with an average of 4,000 plants per acre, a transplanting program designed to achieve current shrub densities on Red Rim in a relatively short time period, would cost from $100,000 to $120,000 per acre. See Table 2, "Program" 1. b.
>
> "At $25 to $50 per 'pad,' contiguous dry-land sodding would cost for $27,000 to $55,000 per acre. See Table 2, "Program" 2.[38]"

Table IV-6 summarizes OSM's estimated costs for certain reclamation activities that could occur on the Red Rim tract. The estimated costs to reclaim an acre of mined land under reclamation scenarios 1, 2, and 3 are respectively $41,284, $31,590, and $21,895, or $6.58, $5.04, and $3.49 per ton of coal produced (assuming a total of 69.0 million tons of coal were produced and 11,000 acres were disturbed). A discussion of these reclamation cost estimates follows. OSM's cost calculations are based on 1985 dollars and costs. Owing to inflation, the actual costs could increase by the time reclamation of the mined land within the tract occurs.

Under the assumptions of reclamation scenario 1, the "micro-topography" of the pronghorn critical winter range would be closely approximated on all mined lands. This would require extensive rehandling of the backfilled spoil material. OSM's analyses, based on D. H. Emling Company (1978) data, indicate that the spoil reclamation handling costs would be approximately $12,000 to $25,000 per acre under this scenario. Important costs not included in this estimate are those associated with the two-lift soil salvaging program described in the reclamation scenario 1 assumptions; with more detailed than normal geomorphic, hydraulic, and hydrologic studies; and with any mechanical structures needed for slope stabilization of the postmining landscape.

In the analyses of topographic restoration costs, OSM also examined reclamation costs for the Arch Mineral Corporation Seminoe No. 1 and Seminoe No. 2 mines (Arch Mineral Corporation, 1981a, v. XII, p. 172; 1981b, v. IX, p. 251) since these mines have a topographic and geological setting similar to the Red Rim area. These mining operations are also similar from a material handling standpoint and are in compliance with current Wyoming DEQ rules and regulations for returning the mined land to an approximate original contour condition (reclamation scenario 3). Based on the Seminoe No. 1 and Seminoe No. 2 mines' data, the Red Rim topographic restoration costs for reclamation scenario 3 would be approximately $18,500 per acre, assuming a dragline operation. This estimate includes topsoil salvaging and replacement as described in the reclamation scenario 3 assumptions. "Micro-contouring" and more selective topsoil salvaging and replacement (reclamation scenario 1) would approximately double these costs to $37,000 per acre.

The approximate revegetation costs for reestablishing big sagebrush communities (basin or Wyoming subtypes) on slopes less that 30 percent, and on slopes equal to or greater than 30 percent, are, respectively, $19,120 and $38,770 per acre (table IV-7). Included in the per acre costs are estimates for transplanting

Table IV-6.--Summary of estimated costs for certain reclamation activities for the Red Rim tract[1]

Type of reclamation	Cost per acre	Total reclamation cost
Cost to reclaim different acreages under reclamation scenario 1		
A. Cost to reclaim acreages to big sagebrush community type:		
1. Cost to reclaim steep slopes (1,100 acres)[1]:		
Topographic restoration[2]	$37,000	
Revegetation and stabilization[3]	38,770	
Total	$75,770	$83,347,000
2. Cost to reclaim moderate slopes (4,500 acres)[4]:		
Topographic restoration[2]	$37,000	
Revegetation and stabilization[3]	19,120	
Total	$56,120	$252,540,000
B. Cost to reclaim acreages to perennial grass and shrub community type (5,400 acres; based on reclamation scenario 3 costs shown below)	$21,895	$118,233,000
Weighted cost average (of A1, A2, and B totals)	$41,284	
Reclamation cost for entire disturbed acreage		$454,120,000
Cost to reclaim different acreages under reclamation scenario 2		
A. Half of acreage of pronghorn critical winter range (2,800 acres) and half of remainder of the disturbed acreage (2,700 acres) reclaimed to meet reclamation scenario 1 criteria	$41,284	$227,422,000
B. Half of acreage of pronghorn critical winter range (2,800 acres) and half of remainder of the disturbed acreage (2,700 acres) reclaimed to meet reclamation scenario 3 criteria	$21,895	$120,422,500
Weighted cost average (of A and B)	$31,500	
Reclamation cost for entire disturbed acreage		$347,484,500
Cost to reclaim different acreages under reclamation scenario 3		
A. Cost to reclaim acreages to perennial grass and shrub community type (11,000 acres):		
Topographic restoration[2]	$18,500	
Revegetation[5]	3,395	
Total	$21,895	$240,845,000

---

[1] Based on mining disturbance of 11,000 acres, 10 percent of which would constitute steep (gradients greater than or equal to 30 percent) slopes.

[2] Based on reclamation costs at Seminoe No. 1 and Seminoe No. 2 mines (includes topsoil placement).

[3] From table IV-7.

[4] Gradients less than 30 percent.

[5] From table IV-8; assumes that sagebrush would be interplanted in most reclaimed areas.

Table IV-7.--Revegetation costs per acre for reestablishment of a basin or Wyoming big sagebrush community type (reclamation scenario 1)

Revegetation material or activity	Revegetation costs (in dollars) for gradients less than 30 percent	Revegetation costs (in dollars) for gradients equal to or greater than 30 percent
Transplant mature sagebrush plants (200/acre)	5,000	([1])
Plant containerized tubelings:[2]		
9,000 tubelings/acre	10,800 ($1.20/tubeling)	----
12,500 tubelings/acre	----	21,625 ($1.73/tubeling)
Plant seed mix:		
Seed mix[3]	100	100
Seedbed preparation	200	600
Seeding	40	120
Mulch and application	520	1,560
Stability/erosion-control practice development and installation		10,000
Fertilizer and application	35	90
Irrigation (first 2 years)	1,250	2,500
Additional watering of tubelings (first year)	1,000	2,000
Baseline data collection and research studies	[4]175	[4]175
Total cost per acre[5]	19,120	38,770

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[1] Steepness of gradient would prevent use of the type of equipment required for transplanting big sagebrush plants.

[2] Cost includes both the price of the tubelings (about 50 percent of cost) and of their planting (about 50 percent of cost). Higher tubeling planting rates are required on steeper slopes owing to greater tubeling mortality on such sites. Sagebrush tubelings should be grown from *Artemesia tridentata* ssp. *wyomingensis* seed collected on Red Rim from individual plants that have proved palatable to pronghorn.

[3] Seed mix = grasses, forbs, and shrubs that have been consistently established from seed.

[4] Costs are detailed in appendix F.

[5] Does not include the cost of monitoring the reclamation effort (minesoil, hydrology, and revegetation) or of overburden special handling, both of which would probably be required.

200 mature sagebrush plants (on slopes less than 30 percent); for planting 9,000 and 12,500 sagebrush tubelings (respectively, on slopes less than 30 percent, and on slopes equal to or greater than 30 percent); for planting a grass, forb, and shrub seed mix; for developing and implementing stability and erosion-control practices; for fertilizing and irrigating; and for conducting detailed baseline data collection and research studies. The higher tubeling planting rates on the steep slopes are attributed to anticipated reduced survival. Higher costs for seedbed preparation, seeding, fertilization, and mulching were estimated for the steeper slope designation based on the fact that only very specialized types of mechanized equipment can be utilized on such steep slopes (Carroll Hammond, Soil Conservation Service, State Office, Denver, Colorado, oral communication, 1983), or that expensive hand labor would be necessary. An irrigation system on the steep slopes would be more expensive than one on lesser slopes owing to increased costs for materials, installation, and maintenance.

The planting rates for big sagebrush transplants and tubelings (table IV-7) were arrived at by taking into consideration expected mortality, potential for short-term reestablishment from mature plant reproduction, and the long-term density of sagebrush required for maintenance of pronghorn critical winter habitat. (See appendix F.) Sagebrush densities on the reclaimed mine would be reduced from the high densities currently on the site. However, the postmining sagebrush forage available to pronghorn would be nearly equal to the premining levels owing to increased size or plant vigor of the sagebrush planted at the lower densities. Further discussion of sagebrush planting rates is included in appendix F.

The cost of reestablishing a perennial grass and shrub community, without and with interplantings (islands) of basin or Wyoming big sagebrush, are, respectively, $2,145 and $3,395 per acre (table IV-8). Atriplex sp.-dominated shrub communities are normally located on those slopes less than 20 percent.

The revegetation cost estimates are based on data from (1) a mined land reclamation seed and shrub supplier (Tom Guobis, Native Plants, Inc., Salt Lake City, Utah, oral communication, 1983), (2) a mined land reclamation researcher (Frank Munshower, Montana State University, Bozeman, Montana, oral communication, 1983), and (3) a Wyoming DEQ memorandum (Pat Boles, written communication, 1983). The data are presented in appendix H.

The big sagebrush reestablishment effort would be used primarily under the scenario 1 reclamation plan with lesser amounts of this type (islands of transplanted sagebrush) being replaced under reclamation scenario 3. The amount of big sagebrush type being reestablished in reclamation scenario 1 would be limited by the availability of soil materials suited for reestablishment of the big sagebrush community type. Under reclamation scenario 1, the perennial grass and shrub community type (see table IV-8, "Revegetation costs without sagebrush interplantings" column) would be planted on those lands which would not be reclaimed to the big sagebrush type. (See table IV-7.) The perennial grass and shrub community type would form the basic plant community being reestablished on the area under reclamation scenario 3. Careful planning in the location of the big sagebrush islands under reclamation scenario 3 would be necessary to provide the best possible mitigation of pronghorn habitat loss.

RME estimated, in its preliminary mine plan (D. H. Emling Company, 1978) and shrub reestablishment study (Rocky Mountain Energy Company, 1982c), that topographic restoration and revegetation activities at the Red Rim tract would

Table IV-8.--Revegetation costs per acre for reestablishment of a perennial grass and shrub community type on slopes less than 20 percent, without and with interplantings of transplanted mature basin or Wyoming big sagebrush plants (reclamation scenario 3)

Revegetation material or activity	Revegetation costs (in dollars) without sagebrush interplantings	Revegetation costs (in dollars) with sagebrush interplantings
Plant seed mix:		
Seed mix[1]	100	100
Seedbed preparation	200	200
Seeding	40	40
Mulch and application	520	520
Transplant mature sagebrush plants (50 plants/stand/acre)[2]	----	1,250
Fertilizer and application	35	35
Irrigation (first 2 years)	1,250	1,250
Total cost per acre	**2,145**	**3,395**

[1] Seed mix = grasses, forbs, and shrubs (such as Atriplex sp.), which can be successfully established from seed.

[2] Transplanting cost calculated on the basis of $25 per plant, which is a minimum cost figure that can be expected to escalate.

cost approximately $12,525 to $14,025 per acre. In contrast, the Jim Bridger mine in Sweetwater County, Wyoming, estimates costs for those activities to amount to $37,230 per acre; the Seminoe No. 2 mine in Carbon County estimates those costs to be $13,716 per acre; and the Dave Johnston mine in Converse County estimates those costs to be $41,470 per acre. (These figures are based on itemized reclamation costs presented in the specific mine permit applications.)

The cost estimates for reclaiming these mines differ because of differences in stripping ratios; the amount of material rehandling required for both mining and reclamation; the equipment used; the production processes and the associated economics of size; the time at which the estimates were made; management intensity and effectiveness; and accounting practices used in assigning costs to mining operations and to reclamation operations.

The costs OSM calculated for Red Rim are comparable to actual costs of reclamation at other mines in Wyoming.

D. SUMMARY OF IMPACTS

Heretofore, in chapter IV, the impacts of mining on primarily wildlife, topography, vegetation, and soils have been analyzed in conjunction with OSM's responses to the petitioners' two primary allegations and supporting statements. (See sections IVB and IVC.) In contrast, this section, in accordance with Section 102(2)(C) of NEPA, summarizes the impacts to all portions of the human environment that were addressed in chapter II. The following wildlife, topography, vegetation, and soils subsections are impact summaries compiled from the previous allegation response sections. The following land use, recreation, geology, climate, air quality, socioeconomics, hydrology, cultural resources, and noise subsections are impact analyses presented for the first time in this document. Many of the impacts identified in these latter subsections were taken from BLM's Green River-Hams Fork regional coal EIS (Bureau of Land Management, 1980) and Red Rim site-specific environmental analysis (Bureau of Land Management, 1981b); additional impact analyses from more recent documents were also included.

1. Wildlife

General discussions of coal development impacts on wildlife resources in the region are presented in BLM's southcentral Wyoming coal EIS and Green River-Hams Fork regional coal EIS (Bureau of Land Management, 1978, 1980).

Sage grouse.--Sage grouse would be adversely affected during mine development and operation as parcels of sagebrush habitat are disturbed. This would result in lower carrying capacity for the area, especially during the winter when sagebrush is essential as cover and food. BLM's Separation Creek riparian zone no surface occupancy area would reduce impacts to grouse broods but would have little impact on loss of important wintering sites for that species.

Mule deer.--The most important impact on the 50 to 150 mule deer using the Red Rim area would be the disturbance of a portion of the approximately 2,900-acre critical winter range located in T. 20 N., R. 89 W., secs. 4, 5, 6, 7, 8, 9, and 18, and in T. 20 N., R. 90 W., secs. 12 and 13, in the northern portion of the petition area and pronghorn critical winter range. The mule deer critical winter habitat along the eastern edge of the petition area would be partially protected by

BLM's pronghorn no surface occupancy area. Impacts on the winter range could be mitigated by a revegetation plan that would include selected important browse species.

Raptors.--The importance of raptors on the petition area was recognized by the BLM, which developed buffer zones on Federal lands to protect nests of high Federal interest species (golden eagles, prairie falcons, and ferruginous hawks; Bureau of Land Management, 1981b). There are several raptor nests on private lands within the petition area. Wyoming DEQ routinely requires mining permit applicants to work cooperatively with USFWS to mitigate impacts on individual nesting raptors. This normally includes development of buffer zones, nest relocations, or artificial nest structures, where applicable. These efforts would substantially reduce the impacts on raptors nesting in the area. Foraging habitat would be disturbed by mining. However, reclaimed lands would support prey for raptors.

Threatened and endangered species.--Pursuant to Section 7 of the Endangered Species Act, OSM prepared a biological assessment that concluded that the designation of Red Rim as either unsuitable or not unsuitable would not affect listed threatened and endangered species. USFWS concurred with this assessment.

Pronghorn.--Approximately 8,600 acres of the 17,582-acre critical winter range would be affected by mining and mining-related activities. Of this 8,600 acres, 5,600 acres would be directly disturbed by the surface mining and facilities. OSM estimates that a maximum of 4,053 acres of critical winter range would be mined and unreclaimed at any one time. This represents 23 percent of the total critical winter range acreage in the Red Rim area. A maximum of 4,900 mined and unreclaimed acres (most of them lying within the delineated critical winter range) would be unavailable to pronghorn during the life of the mine.

Any mining and reclamation scenario for Red Rim would result in the following effects on pronghorn: (1) habitat would be disturbed and reclaimed in parcels, (2) some areas of critical winter range would be undisturbed and accessible to pronghorn, and (3) reclaimed lands would support some level of pronghorn use 10 to 12 years after planting. Therefore, the carrying capacity of Red Rim would be reduced and reclaimed in stages.

If the Red Rim tract were leased and if a mining plan were approved, Wyoming GFD would probably reduce its population-management objective for the Baggs Herd to a level consistent with a lower, mining-related carrying capacity for the Red Rim critical winter range. Additional hunting licenses would be issued and special hunting seasons opened until the desired population for the herd was achieved. In the short term, there would be an increase in revenue from license sales and hunt-related spending. Once the new, lower population objective was achieved, Wyoming GFD would set a lower harvest number and, therefore, would issue fewer licenses. The annual revenue loss would depend on the difference between the Wyoming GFD population-management objective and the new, lower pronghorn population level dictated by the lower carrying capacity of the critical winter range. This spending loss would continue as long as Red Rim's carrying capacity was below the premine capacity. If the population reductions of the Baggs Herd prior to mining were not accomplished, the pronghorn occupying the Red Rim area would be displaced to adjacent unmined habitat. This displacement would likely result in increased intraspecific competition for food and cover. Additional overcrowding could result, leading to degradation of range conditions and inadequate nutrition for pronghorn and, consequently, in increased mortality, increased susceptibility to disease, and reduced chances for pronghorn does to produce healthy young.

Wyoming GFD estimates that a maximum of one-third of the Baggs Herd depends upon the petition area for survival. Therefore, assuming that at the time of mining the population of the herd equaled the population-management objective for it and that the objective was 7,200 pronghorn (its current level), 2,400 pronghorn (one-third of 7,200) would depend upon the 19,452-acre Red Rim petition area for survival. OSM estimates that, during a severe winter, pronghorn mortality owing directly to habitat loss due to mining could range from 53 to 1,205 (0.7 to 17 percent of the herd), depending upon the extent of unreclaimed mining disturbance at the time the severe winter occurred. Assuming that a severe winter occurred once every 5 years, approximately 6,800 pronghorn could die over the life of the mine as a direct result of habitat loss. This estimate describes the number of pronghorn that could die over the short term (during the life of the mine) as the direct result of habitat not being available to them owing to ongoing mining and reclamation operations; pronghorn lost in this manner would be additional to those lost from natural causes, irrespective of mining, during severe winters.

Several other factors could account for considerable additional pronghorn losses over the short term. Among these factors are that (1) fences, spoil piles, pits, and other mining-related disturbances and facilities would exclude pronghorn from portions of the critical winter range, exposing them to the elements during severe snowstorms and causing them to overexert themselves to move around barriers and to locate shelter and accessible forage elsewhere; exposure and overexertion would, in turn, lead to increased mortality and decreased reproductive capability; (2) fences could entangle pronghorn trying to cross them or otherwise entrap pronghorn during severe snowstorms; and (3) poaching, road kills, and harassment would increase owing to the influx and increased activity of people in the Red Rim area. These short-term, adverse impacts would occur under all of the mining and reclamation scenarios discussed in this PED/EIS (reclamation scenarios 1, 2, and 3); they would be significant to the Baggs Herd.

In addition to short-term impacts, long-term impacts to the herd would result under reclamation scenario 3. If Red Rim were reclaimed using standard reclamation practices (those reclamation techniques that both minimally comply with the requirements of the Wyoming State program and are currently being used in the State to reclaim areas disturbed by surface coal mining operations; reclamation scenario 3), the carrying capacity of the critical winter range would be reduced beyond the life of the mine, possibly for a very long period following mining. The cumulative long-term loss of pronghorn resulting from this long-term reduction in carrying capacity could be large; adverse impacts to the herd from the reduction could be significant.

Even though the impacts of mining on the Baggs Herd would be significant, mining would not destroy the Red Rim pronghorn population, but would only reduce it. The species would not be threatened; numerous other pronghorn herds in Wyoming and other States would be unaffected.

2. Vegetation and Soils

During construction and operation of a mine on the Red Rim area, existing vegetation and soil profiles would be destroyed on approximately 12,000 acres in the proposed coal lease tract. Under reclamation scenario 1, it is estimated that the minesite, including the pronghorn critical winter range, would be returned to a reduced forage production capacity, with emphasis on shrubs (primarily sagebrush), that would receive some pronghorn and domestic livestock use within about 10 to 12 years after initial disturbance. Under reclamation scenario 3, the forage production could receive some use after the same 10- to 12-year time period, but the major revegetation emphasis would be shifted from shrubs for pronghorn to a multiple-use native grassland for livestock grazing and wildlife. Under reclamation scenario 3, there would be a long-term reduction in the amount of forage available to pronghorn and of the carrying capacity for wintering pronghorn on all mined lands within the critical winter range (5,600 acres), since only some of the vegetation and topographic components essential to wintering pronghorn would be restored. The overall result of reclamation scenario 2 would be a condition intermediate between the two preceding reclamation scenarios, because half of the mined area in this checkerboard land ownership area would be reclaimed as in reclamation scenario 1, and the other half reclaimed as in reclamation scenario 3. Under reclamation scenario 2, there would be a long-term reduction in the amount of forage available to pronghorn and in the carrying capacity for wintering pronghorn on approximately half the mine lands within the critical winter range (2,800 acres). Long-term productivity would depend largely on range management practices employed by BLM and private landowners, and the management of the Baggs Herd by the Wyoming GFD. Vegetation patterns, densities, and diversity would not be restored during the 30 to 35 years of mine life and the minimum of 10 years for bond release after planting.

3. Topography

Under reclamation scenario 1, the topography of the mined area would be returned to a condition that would closely resemble the existing topography. Drainage density, hillslope orientation, hillslope shape and gradient, and stream-channel geometry and profile would closely resemble the premining configurations. Under reclamation scenario 3, the number of small swales and draws, which provide shelter to the pronghorn and increased moisture to the vegetation, would be reduced after reclamation. A reduction in elevation caused by extraction of the coal would be greatest in those areas where the small hills and ridges would be mined through.

Topographically, the postmining landscape under reclamation scenario 3 would consist of a much less diverse landscape than that under reclamation scenario 1 and the premining condition. Under reclamation scenario 1, slopes greater than 32 percent (including many steep side slopes in draws) probably could not be restored to a long-term stable condition using conventional mining and reclamation techniques. In general, the gross topography would be emulated in reclamation scenario 3, but many of the secondary ridges and drainages would not be constructed. This is expected to reduce the local snow accumulation associated with these secondary features.

In addition to the reduction in number of secondary ridges, reclamation scenario 3 would reduce the number of channels, as indicated by a decrease in the drainage density from existing conditions. Therefore, the drainage density affording shelter to pronghorn under reclamation scenario 3 would be much lower than under reclamation scenario 1.

Sediment yields are not available for reclamation scenario 1 conditions, but it is projected that the sediment yield would be greater than for natural conditions and somewhat greater than for reclamation scenario 3. This is due to the steepness of some of the slopes to be constructed under reclamation scenario 1.

4. Land Use

An estimated total of about 12,000 acres of rangeland and wildlife habitat within the petition area would be disturbed by mining and ancillary facilities. Because of concurrent reclamation, not all of this acreage would be disturbed at any one time. If all the disturbed acreage were removed from forage production, a total of 1,425 AUM's would be lost for grazing or wildlife use. Considering rangeland use, this is only 4 percent of the total production of all four allotments that are affected, and is not significant to the ranching in the area.

Pipelines, the railroad, and power and telephone lines would have to be removed, relocated, or avoided during mining.

5. Recreation

Hunting of the Baggs Herd would probably change if mining were approved. Initially, prior to mining, Wyoming GFD would probably reduce the population-management objective for the Baggs Herd to compensate for the anticipated lower carrying capacity of the petition area. Assuming that the Baggs Herd population was above this new population-management objective, the method Wyoming GFD would probably employ to reduce the herd to the new objective would be to issue more licenses in order to increase hunter take. Therefore, hunter use would increase just prior to mining. However, once the pronghorn population was reduced, Wyoming GFD would probably also reduce its license sales. Thus, in the long term, opportunities for big game hunting in the area would decrease. Depending on the wishes of the surface owner, hunting activity would probably be eliminated on the petition area during construction, mining, and reclamation.

Owing to the relatively stable projected growth trends in Carbon County over the next decade, the indirect impacts of mining on recreation in the county would be minimal. (See the "Socioeconomics" subsection of this section.)

There are no recreation facilities or wilderness areas on the Red Rim petition area and the land is little used by the public except for dispersed recreation such as off-road vehicles, hunting, rock collecting, and sightseeing. Should the area be mined, the plant site, transportation facilities, and annual mining operations would physically eliminate up to 350 acres of potential hunting ground in any one year. However, in fact, the acreage withdrawn from recreational uses would be appreciably larger for safety reasons. The acreage of this larger area cannot be predetermined because it depends on the extent of protection the mining company would give to mine personnel and equipment, and to the land being mined and reclaimed. The improved access to the area probably would result in some taking of game out of season. Additional private land probably would be posted in the general area. Use of regional recreation areas (e.g., Medicine Bow National Forest, Seminoe Reservoir) will increase irrespective of whether or not the petition area is mined.

With a mine, use of public recreation facilities in Rawlins would increase slightly from years 1993 through 2000. However, by the time the mine is constructed, an indoor recreation center should be in operation in Rawlins and should adequately serve the projected population.

6. Geology

If the coal deposits underlying the Red Rim petition area were mined, 69.0 million tons of coal could be removed. (Note: It is assumed in section IVA that BLM's Separation Creek riparian and zone, eagle nest buffer zones, and pronghorn no surface occupancy areas would be adopted as proposed by BLM; 3.1 million tons of Federal and private coal, which would be precluded from extraction by these two areas, is not included in the 69.0-million-ton total.) An average of approximately 2 million tons of coal per year could be removed by a 30- to 35-year mining operation. An additional 11 million tons of coal in the area would be lost because of limitations in mining technology and the economic constraints of mining seams less than 4 feet thick.

The lenticular beds of sandstone, siltstone, and shale that make up the overburden and interburden in the area would be broken up and mixed during removal of coal and replacement of spoils. The resulting replaced overburden would be more uniform and less lenticular.

Although some paleontological resources would be lost by mining, this loss is not considered significant because similar fossils exist throughout the area.

7. Climate

The microclimate near the ground in the petition area would be modified locally by mining until revegetation is successful. Soil temperatures and near-ground temperatures would be higher in areas of bare soil than in areas of vegetated land, and moisture availability in the A-horizon of the soil would be reduced. These conditions would reduce habitat for the microbiota that live in the soil. Wind speed directly adjacent to the ground surface would be slightly higher, thereby increasing erosion and mechanical abrasion of exposed soil by moving particles.

The microclimate in the steeper sided draws might be permanently modified by mining because these features would be very difficult to reconstruct. Following reclamation, they probably would not be either as steep-sided or as deep as they are at present; thus, their ability to collect snow and to protect pronghorn from the wind might be reduced. Overall impacts to the climate of the area would be negligible.

8. Air Quality

Any impacts to air quality resulting from, or associated with, mining the Red Rim petition area would occur only during the life of the mine. During this time, TSP concentrations would be increased in the vicinity of the mine; maximum TSP concentrations would shift, following the mining sequence. The expected maximum annual TSP concentration, including baseline concentration, would be less than 25 $\mu g/m^3$ outside of the mining plan boundary (Bureau of Land Management, 1980). This estimated concentration is less than both the State and Federal annual TSP standards (60 $\mu g/m^3$) and was derived based on the assumption that the mine would use best available control technology to control fugitive dust and other emissions. The impact of this TSP concentration would be minor. Concentrations of gaseous emissions would increase only slightly because few major emissions sources would be present on the minesite.

9. Socioeconomics

The development of a mine on the Red Rim tract would have minimal social and economic impacts on the city of Rawlins and Carbon County. According to the Carbon County Planning and Development Department (1983), the major existing energy developments in the county would be exhausing their energy resources and shutting down operations between 1993 and 1997. The petition area mine would become operational at about this same time. Thus, any mine-related population could be accomodated by those public services and facilities in operation from 1993 to 1997. Without the mine, the population of Carbon County would increase from 19,388 in 1982 to 22,464 in 1997; with the mine, population would increase to 23,668 in 1997. For these same years, the Rawlins population would increase from 11,082 to 12,075 without the mine and to 13,159 with it.

According to the Carbon County Planning and Development Department (1983), a 2-million-ton-per-year mine would require a construction workforce of 55 people from 1993 to 1995; its peak operational workforce of 175 would be on the job by 1997 (table IV-9). Beginning in 1997, and throughout the 30-year life of the mine, the company would be paying over $5.3 million per year in wages and salaries to its direct employees (Bureau of Land Management, Rawlins District Office, oral communication, 1983).

The construction workforce would generate approximately 11 secondary jobs; the operational workforce would generate 179 secondary jobs. Thus, by 1997, 354 additional permanent workers would be associated with the mine.

The total 1997 mine-related population is projected to be 1,204. Approximately 90 percent (1,084) of these people are expected to live in Rawlins; they would increase the city's projected 1997 population without the mine by 9 percent. Overall, with or without the mine, Carbon County's population is projected to increase less than 1 percent annually from 1993 to 1997. Rawlins' population is expected to decrease very slightly without the mine from 1993 to 2000 and to increase less than 1 percent with the mine during the same period. The number of school-age children whose parents would be associated with the operation of the mine would peak in 1997 at approximately 297 children. These 297 students would increase the projected student body without the mine by about 10 percent.

By 1997, the number of housing units required by the mine-related population would be 220 single-family units and 46 bachelor units. Currently, there are approximately 600 housing units available for rent or sale in Rawlins, owing largely to cutbacks in, or closures of, energy-development projects in the area. This trend is projected to continue through 1990.

The impact of mine-related population on public services and facilities in Rawlins and Carbon County will be minimal. Most such services and facilities will be adequate to accomodate this population by the time it arrives. The existing wastewater treatment facility in Rawlins will service 23,000 people; existing schools can accommodate an enrollment of between 3,500 and 3,800 students; and health and safety services, if improved, could meet increased demands through the next decade.

Table IV-9.--Demographic variables with and without mining at Red Rim

(Source: Carbon County Planning and Development Department, 1983. Carbon County Planning and Development Department's population forecasts represent the "moderate growth scenario" and are based, in part, on BLM, Rawlins District, and Wyoming Economic Development and Planning Department estimates of the impact of energy development on area populations. NC = No change. Note: Forecasts do not include March 1983 layoffs (200) at the Union 76 uranium mine)

Year	1982	1985	1990	1993	1995	1997	2000
Red Rim direct employment:							
Construction	0	0	0	55	55	0	0
Operation	0	0	0	0	0	175	175
Total indirect	0	0	0	11	11	179	179
Total employment	0	0	0	66	66	354	354
Carbon County population:							
With mine	19,388	17,780	22,886	22,698	22,493	23,668	23,808
Without mine	19,388	17,780	22,886	22,577	22,372	22,464	22,604
Net	NC	NC	NC	121	121	1,204	1,204
Rawlins population:							
With mine	11,082	10,950	12,135	12,236	12,194	13,159	13,164
Without mine	11,082	10,950	12,135	12,115	12,073	12,075	12,080
Net	NC	NC	NC	121	121	1,084	1,084
Rawlins households:							
With mine	3,958	3,911	4,334	4,370	4,355	4,700	4,701
Without mine	3,958	3,911	4,334	4,327	4,312	4,313	4,314
Net	NC	NC	NC	43	43	387	387
School District No. 1 enrollment:[1]							
With mine	2,901	2,660	3,113	3,135	3,123	3,393	3,394
Without mine	2,901	2,660	3,113	3,107	3,095	3,096	3,097
Net	NC	NC	NC	28	28	297	297

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[1] David Spencer, Rawlins City Planning Department, oral communication, March 1983.

Carbon County's and Rawlins' priorities for meeting growth demands include:

- Constructing a projected $2 million indoor recreation center in Rawlins.

- Replacing water transmission lines at a projected cost of $8.5 million.

- Constructing a projected $575,000 county jail (Carbon County Council of Governments, 1980).

Currently, public officials' attitudes toward capital expenditures and improvements is favorable; they feel that it is beneficial to the city and county to create new sources of employment and income for area residents.

At full production, the Red Rim mine would contribute the following annual revenues:

- $92,000 in local property taxes.

- $8.0 million in State severence tax.

- $3.75 million in Federal royalties (Bureau of Land Management, 1980).

These revenues would help offset revenues lost from projects phasing out during the 1990's.

The social impacts of a mine at Red Rim would be negligible. The majority of residents in the county have lived through the "boom" cycle of the 1970's and, so, are accustomed to the influx of newcomers to the area. (For a complete discussion of potential social impacts to Carbon County see the Green River-Hams Fork regional coal EIS (Bureau of Land Management, 1980).)

Given when it would begin construction and operation, any such mine should help to stabilize the local energy-related economy and population; conversely, without a mine, the energy-related economy could suffer owing to the anticipated closing of other energy developments in the county when their energy resources are depleted. If, however, current energy development and growth trends are reversed, and Carbon County were to experience a "cumulative high-growth scenario," the county and its jurisdictions would suffer severe adverse socioeconomic impacts, with or without the Red Rim mine (Bureau of Land Management, 1980).

10. Hydrology

Surface water.--Continuous changes in runoff characteristics and sediment discharge would occur during mining because of changes in the location of diversions and other ditches and the destruction and reconstruction of drainage channels as mining progresses. Because of scour and erosion in the reclaimed areas, sediment discharges could reach high values on the disturbed areas. However, both Wyoming and Federal regulations require that all surface runoff from affected lands must pass through sedimentation ponds. Therefore, the sediment would be trapped in sediment ponds before leaving the permit area. A portion of the sediment produced by large storms (greater than the 10-year, 24-

hour storm) could affect areas downstream. The sediment ponds would, however, partially reduce the impact of larger storms. Downstream impacts from large storms could increase if the ponds were full of water and sediment at the time of the storm or if the runoff caused a dam to fail. (OSM and Wyoming DEQ have regulations for dam construction which must be met by the permittee; a dam failure is considered to be a remote possibility.) However, all sediment ponds would be required to have emergency spillways capable of safely passing the runoff from at least a 25-year, 24-hour storm.

Runoff would increase somewhat due to loss of soil structure during soil removal and replacement. Vegetation (after successful reclamation) would retard surface flows so as to control runoff at approximate premining levels. The decrease in average slope of the reclaimed land would increase infiltration and reduce the peak flows within the mine area.

Very small decreases in the base flow of Separation Creek could occur as the open pit drains the upper beds of the Fort Union Formation and prevents the ground water from reaching the creek.

After mining and reclamation are complete, surface-water flow and quality and sediment discharge from the total permit area would approximate premining conditions.

Ground water.--The ground-water resources of the petition area would be impacted by mining in several ways: (1) mining would remove the coal and disrupt the continuity of the lenticular sandstones of the Fort Union Formation; (2) water levels in the Fort Union adjacent to the mine would be lowered as a result of seepage into the open pit; (3) the head in the basal sandstone of the Fort Union would be lowered near the mine as a result of pumping water to supply the mine; and (4) the quality of the ground water in the Upper Fort Union would be reduced as it flows through the replaced overburden.

None of these impacts would be significant because: (1) the replaced overburden would form an aquifer with hydrologic properties similar to those of the present Upper Fort Union Formation; (2) most wells would still be able to supply sufficient water despite their lowered water levels, and the basal sandstone of the Fort Union would be available as a replacement for any shallow wells that may go dry; and (3) the ground-water quality would still be suitable for watering livestock and wildlife, the major current use.

Some long period of time (probably more than 100 years) after mining is completed, ground water in the area would recover its present, normal level.

11. Cultural Resources

Numerous cultural resources in the petition area would be directly impacted by surface mining and by haul roads, plant facilities, and so forth associated with it. Until the area is surveyed further, and sites evaluated for their significance and eligibility for nomination to the National Register of Historic Places, no determination of the beneficial or adverse effect of impacts, pursuant to 36 CFR 800, can be made. Sites surrounding the immediate petition area may be affected by increased mine-related population and access to the minesite, which, in turn, would increase recreational activities in the area and may increase vandalism.

Inventories of the petition area, or the methods of those inventories, may not have located all sites or artifacts. In addition, those sites or artifacts deemed insignificant now, and so not inventoried or collected, may, in the future, be deemed critical to the interpretation of past ways of life. Therefore, mining of the petition area could constitute an irreversible loss of nonrenewable cultural resources. If mining is approved in the area, measures (including further survey, data recovery from sites, avoidance of sites, and making the public aware of the value of sites) would be taken to minimize any potential adverse impacts to these resources.

Potential beneficial impacts of mining the Red Rim tract to cultural resources include the opportunity to recover data regarding (1) historic and prehistoric ways of life in the area and (2) the location and types of cultural resources in the area.

12. Noise

A mine on the Red Rim tract would increase noise from a general level of approximately 20 decibels to approximately 78 decibels at 500 feet from each active strip pit (Bureau of Land Management, 1980). Noise levels at the tract boundary are projected to be 60 decibels or less (Bureau of Land Management, 1980). Noise would increase on Interstate 80 and the railroad line to the north of the tract as the result of increased traffic associated with the mining operation.

Excepting those workers at the minesite, human receptors to the noise from the mining operation would be an anticipated small number of persons seeking recreational opportunities near the mine or those persons located at the Daley Ranch, approximately 1 mile from the proposed coal lease tract boundary and 1½ miles from the nearest coal seam that would be mined. The impacts to humans associated with noise are: minor physiological reactions; behavioral interference with activities such as speech, sleep, and work; and subjective effects such as annoyance (Bureau of Land Management, 1980). Because the increase in noise levels is anticipated to be generally small, the significance of the noise impacts to humans would be low.

This increase in noise level is expected to have little effect on pronghorn. Segerstrom (1982) found that pronghorn adjusted to many types of routine mining activities. There could be isolated instances when equipment operations might surprise and unexpectedly frighten pronghorn.

E. THE RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF MAN'S ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

The following is an analysis of the impacts that would occur if the mining of the petition area is allowed.

Based on anticipated production levels, the proposed Red Rim coal lease tract would be committed to coal production for 30 to 35 years. During this time, mining would result in the introduction of additional roads, railroads, powerlines, fences, mine structures, and associated human populations into southcentral Wyoming, an area already undergoing change from a semiagriculturally based economy to coal and uranium mining, and oil and gas activities. This increase in population would create an increased demand for all public services. Overall, the open, basically treeless landscape would be visibly intruded more by the construction, equipment, and other human activities due to the increased population than by mining excavation and reclamation. Part of this intrusion would still be in evidence long after coal mining has ceased.

As the coal is mined, almost all components of the present ecological system, which have developed more or less harmoniously on the affected land over a long period of time, would be modified and in some cases destroyed. The degree to which the resources of the petition area would be impacted and modified is largely dependent upon the details of the reclamation plan which OSM and Wyoming DEQ would require for the restoration or mitigation of the pronghorn critical winter range on the petition area (analyzed as reclamation scenarios 1, 2, and 3 in preceding sections of this chapter).

The postmining topography of the area could very closely resemble the premining condition (reclamation scenario 1) on the entire area, or only approximate the original contour (reclamation scenario 3), or result in a checkerboard pattern of the two preceding types of topographic restoration on alternating sections of land (reclamation scenario 2). In the latter two situations, the reclaimed landscape on all or half of the mined area, respectively, would be topographically lower, and it would lack some of the original variety of geometric form.

During construction and operation of a mine on the Red Rim area, there would be a loss of vegetation on approximately 12,000 acres and an accompanying disturbance of pronghorn winter range and grazing land. Under reclamation scenario 1, it is estimated that the minesite would be returned to a reduced forage production capacity, with emphasis on shrubs (primarily sagebrush), that could receive some pronghorn and domestic livestock use within about 10 to 12 years after initial disturbance. Under reclamation scenario 3, the forage production could receive some use after the same 10- to 12-year time period, but the major revegetation emphasis would be shifted from shrubs for pronghorn to a multiple-use native grassland for livestock grazing and wildlife. The overall result of reclamation scenario 2 would be a condition intermediate between the two preceding reclamation scenarios, because half of the mined area in this checkerboard land ownership area would be reclaimed as in reclamation scenario 1, and the other half reclaimed as in reclamation scenario 3. Long-term productivity would depend largely on range management practices employed by BLM and private landowners, and the management of the Baggs Herd by the Wyoming GFD. Vegetation patterns, densities, and diversity would not be restored during the 30 to 35 years of mine life and the minimum of 10 years for bond release after planting.

Utilizing the intensive reclamation techniques of reclamation scenario 1 to restore the premining topography and sagebrush production, there would be a 10- to 12-year lag before restored lands could support some level of pronghorn use. There would be a short-term reduction in the carrying capacity of the entire petition area during the life of the mine. Under reclamation scenario 3, the pronghorn carrying capacity of the entire mined area may not be restored in the forseeable future, owing to a restoration of only the approximate original contour on the pronghorn critical winter range and to a reduced level of sagebrush production. If reclamation scenario 2 were implemented, there would be a short-term reduction in the carrying capacity on half of the mined area (as in reclamation scenario 1), and on the other half a reduced carrying capacity for a much longer undetermined period of time (as in reclamation scenario 3).

Under any reclamation plan, the Baggs Herd would probably be managed by Wyoming GFD at a lower population level than if mining did not occur for at least 40 to 45 years after initiation of mining (30 to 35 years during the life of the mine and 10 years for reclamation prior to bond release) to compensate for the reduced pronghorn carrying capacity on Red Rim. Under reclamation scenarios 2 and 3, Wyoming GFD could be forced to manage the herd at a reduced population level during a much longer indefinite time period when carrying capacity is still below premining levels.

There would be a deterioration of the ground-water quality in the mine area because of mining. This deterioration would probably take place over a long period of time. The water quality would still be adequate for livestock. Some long period of time (probably more than 100 years) after mining is completed, ground water in the area would recover to its present, normal level.

Mining operations and associated activities would degrade the visual resources of the area on a short-term basis. Following removal of surface facilities and completion of reclamation, the long-term impact on visual resources would be minor.

In the short and long term, the greatest impacts to recreation values by a mine would be those associated with pronghorn hunting on both the petition area and in other portions of the Baggs Herd unit area. Prior to and during mining, Wyoming GFD would probably reduce the pronghorn population by issuing more hunting licenses to avoid overcrowding on the petition area. Therefore, hunter use on the petition area and adjoining areas within the Baggs Herd unit area would increase in the short term just prior to mining. However, once the pronghorn population is reduced, Wyoming GFD would probably also reduce its license sales. This, combined with a potential long-term reduction in the carrying capacity and potential reduction of the Baggs Herd population for a long period of time beyond mining and reclamation (reclamation scenarios 2 and 3), could, in the long term, decrease opportunities for pronghorn hunting in the area.

A mine on Red Rim would provide permanent employment directly and indirectly to about 354 workers, thereby enhancing the long-term economy of the region. Given that a mine on Red Rim may commence operations about the time other major energy resources are shutting down operations, the mining operation could, in the short term, help to stabilize the local energy-related economy and population. The social impacts of a mine on Red Rim would be short term and negligible.

Development of mine operations and ancillary facilities would result in increased rail and highway use to move construction workers and necessary materials to the various construction sites and to transport coal. All facilities developed for short-term purposes would probably continue to be used over the long term.

Increased traffic noise and road dislocations related to construction would be short-lived--a few years. However, operation of the railroad and mine would result in longer-term noise, increased traffic conflicts, and esthetic impacts for the duration of operations.

F. IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

The following is a discussion of the irreversible and irretrievable commitment of resources that would occur if the mining of the petition area is allowed.

The major commitment of resources would be the mining and consumption of 69.0 million tons of coal to be used for electrical power generation or other uses during the 30 to 35 years of mining. It is estimated that 1 to 2 percent of the energy produced would be required to mine the coal.

The quality of topsoil on approximately 12,000 acres would be irreversibly changed. Soil formation processes, although continuing, would have been irreversibly altered by mining-related activities. Replaced topsoil material would be unlike that in surrounding unmined areas.

Such materials as steel, aluminum, and copper used for the railroad and transmission lines and in the manufacturing of mining machinery and buildings would be committed for the life of the various projects, but much of it would be salvageable upon abandonment.

Loss of life would occur due to both the mining operations and increased vehicular and train traffic. On the basis of strip-mine accident rates in Wyoming as determined by the Mine Safety and Health Administration for 1980, fatal accidents would occur at the rate of 0.02 per 200,000 man-hours worked. Disabling (lost-time) injuries would occur at the rate of 2.76 per 200,000 man-hours worked. This would be an irretrievable commitment of human resources.

In all likelihood, disturbance of all known historic and prehistoric sites on the minesite would be mitigated. Any accidental destruction of presently unknown archeological or paleontological values would be irreversible and irretrievable.

The forage and associated grazing and wildlife habitat that the affected land provides would be lost during the period of mining and reclamation. Depending upon the conditions of the mining and reclamation plan that is approved, the diverse topography of the petition area, which is important to pronghorn of the Baggs Herd, may be only partially restored.

Water would be consumed by domestic use, plant and equipment cleaning, fire control, and dust suppression. Although the quality of the ground water would be decreased, the water still would be acceptable for the anticipated postmining uses for livestock and wildlife.

CHAPTER V

ALTERNATIVE ACTIONS

This chapter addresses the possible alternative decisions on the Red Rim unsuitability petition (alternatives A through E), described in chapter I, as follows. First, it distinguishes which of these alternatives are reasonable according to criteria set forth by NEPA (alternatives A through D). Second, it describes and summarizes the probable impacts of implementing each of the alternative decisions found by OSM to be both reasonable and practicable and, therefore, available to the Secretary of the Interior (alternatives A through C1). OSM identifies these probable impacts as either short- or long-term. OSM considers impacts to be short-term if they would occur during the life of the mine (assumed to be about 40 to 45 years: 30 to 35 years for mining and reclamation operations, and a minimum of 10 years for bond release after seeding, fertilizing, irrigation, or other work to ensure revegetation is completed) and long-term if they would persist after mining and reclamation have been completed. Table V-1 compares the impacts to Red Rim's more important resources of implementing each of the reasonable and practicable alternatives. The table lists impacts that are discussed in this chapter and in chapter IV. Finally, this chapter restates OSM's rationale (1) for determining alternatives C2, D, and E not to be practicable or reasonable and, therefore, not to be available to the Secretary and (2) for deciding not to analyze these alternatives further.

In comparing the impacts of adopting each of the various alternatives, OSM assumes that the boundaries of the BLM Separation Creek riparian zone, golden eagle nest buffer zones, and pronghorn "no surface occupancy areas," as currently proposed, would not change prior to BLM leasing the tract. The effect of adopting these no surface occupancy areas as proposed would be to limit the amount of surface disturbance under every alternative except alternatives A and E. For further discussion of the BLM no surface occupancy areas as they would affect the areas mined under alternatives B through D, see section ID. Also see section ID for maps showing the locations of the no surface occupancy areas and of the different portions of the petition area that would be designated unsuitable for surface coal mining operations under alternatives A through C.

CEQ's regulations for implementing procedural provisions of NEPA require an agency preparing an EIS to identify which of the alternative Federal actions addressed in the EIS constitutes its preferred alternative action (40 CFR 1502.14(e)). OSM's preferred alternative for the Red Rim unsuitability petition is alternative B4.

A. ALTERNATIVE A: DESIGNATE THE ENTIRE PETITION AREA AS UNSUITABLE FOR ALL SURFACE COAL MINING OPERATIONS

Under this alternative, the Secretary of the Interior would find either (1) that the mandatory criterion of Section 522(a)(2) of SMCRA has been met (that is, that mining and reclamation would not be technologically and economically feasible) or (2) that, under the discretionary criterion of Section 522(a)(3) of SMCRA, the potential for significant damage to important natural systems in the petition area should preclude surface coal mining operations.

Table V-1.--Comparison of impacts of the alternatives

Alternative	Resource					
	Pronghorn	Topography	Vegetation	Soils	Socioeconomics	Coal resources
Alternative A: Designate the entire petition area as unsuitable for all surface coal mining operations.	Critical winter range preserved. Baggs Herd population managed in accordance with Wyoming GFD population-management objectives.	Diverse topography and windswept slopes of critical winter range preserved.	Current vegetation densities and patterns preserved.	Current soil profiles and distribution of soil mapping units preserved.	No positive economic impacts from mining to Rawlins or Carbon County.	None of the 69.0 million tons of coal recovered.[1]
Alternative B: Not designate any of the petition area as unsuitable for surface coal mining operations.	One-third of critical winter range mined (5,600 acres). Baggs Herd population reduced by Wyoming GFD prior to mining. Carrying capacity of the critical winter range reduced over the short to long term. Owing to habitat loss due to mining, 53 to 1,205 pronghorn would die in a severe winter, 6,800 over the life of the mine. Significant adverse impacts on Baggs Herd.	Land surface lowered and average slopes decreased (11,000 acres). Swales and draws used by pronghorn for shelter reduced. Snow accumulation patterns changed, owing to changes in topography.	Vegetation patterns, densities, and diversity changed over the long term (12,000 acres). Limited forage for pronghorn provided by postmining vegetation.	Soil horizons intermixed (12,000 acres). Erosion increased over the short term.	Minimal adverse social and economic impacts to Rawlins and Carbon County; population, employment, and incomes increased.	69.0 million tons of coal recovered.[1]
Alternative B1: Not designate as unsuitable for surface coal mining operations the entire petition area on the basis that the area, including all pronghorn critical winter range within it, would be reclaimed to closely approach its premining condition (reclamation scenario 1).	One-third of critical winter range mined (5,600 acres). Baggs Herd population reduced by Wyoming GFD prior to mining. Carrying capacity reduced over the short term. Owing to habitat loss due to mining, 53 to 1,205 pronghorn would die in a severe winter, 6,800 over the life of the mine. Significant adverse impacts on Baggs Herd.	Premining topography restored, although land surface somewhat lowered and average slopes somewhat decreased (11,000 acres). Shelter for pronghorn provided by reclaimed landscape.	Vegetation patterns, densities, and diversity changed over the long term (12,000 acres). Shrub forage for pronghorn restored within 10 to 12 years after planting.	Same as alternative B.	Same as alternative B.	69.0 million tons of coal recovered.[1]
Alternative B2: Not designate as unsuitable for surface coal mining operations the entire petition area on the basis that half the area would be reclaimed to closely approach its premining condition; the other half would be reclaimed using standard reclamation practices to a multiple-use native grassland for livestock grazing and wildlife habitat (reclamation scenario 2).	One-third of critical winter range mined (5,600 acres). Baggs Herd population reduced by Wyoming GFD prior to mining. Carrying capacity reduced over the short term for half of land reclaimed under reclamation scenario 1 (see alternative B1), over the long term for other half of land reclaimed under reclamation scenario 3 (see alternative B3). Owing to habitat loss due to mining, 53 to 1,205 pronghorn would die in a severe winter, 6,800 over the life of the mine. Significant adverse impacts on Baggs Herd.	Same as alternative B1 for half the mined land; same as alternative B3 for other half.	Same as alternative B1 for half the mined land; same as alternative B3 for other half.	Same as alternative B.	Same as alternative B.	69.0 million tons of coal recovered.[1]
Alternative B3: Not designate as unsuitable for surface coal mining operations the entire petition area on the basis that the area, including all pronghorn critical winter range within it, would be reclaimed using standard reclamation practices to a multiple-use native grassland for livestock grazing and wildlife habitat (reclamation scenario 3).	One-third of critical winter range mined (5,600 acres). Baggs Herd population reduced by Wyoming GFD prior to mining. Owing to habitat loss due to mining, 53 to 1,205 pronghorn would die in a severe winter, 6,800 over the life of the mine. Carrying capacity reduced over the long term. Significant adverse impacts on Baggs Herd.	Same as alternative B but magnitude of impacts increased.	Same as alternative B but magnitude of impacts increased.	Same as alternative B.	Same as alternative B.	69.0 million tons of coal recovered.[1]

Table V-1.--Comparison of impacts of the alternatives--Continued

	Resource		Resource			
Alternative	Pronghorn	Topography	Vegetation	Soils	Socioeconomics	Coal resources
Alternative B4: Not designate as unsuitable for surface coal mining operations the entire petition area but require the lessee to demonstrate the success of reclamation of the pronghorn critical winter range in the north portion of the Red Rim coal lease tract before allowing the south portion of the tract to be mined.	Approximately one-fifth of critical winter range (3,500 acres) mined initially in north portion. If only north portion mined, acreage mined and magnitude of impacts increased slightly over those of alternative C1a. If both north and south portions mined, carrying capacity of critical winter range reduced over the short to long term, depending on condition of the approved mining plan (i.e., whether reclamation would occur as proposed under alternative B, B1, B2, or B3).	Same as alternative B on mined areas. However, if only north portion mined, magnitude of impact decreased from that of alternative B, because only about half of lease tract would be mined.	Same as alternative B on mined areas. However, if only north portion mined, magnitude of impact decreased substantially from that of alternative B, because only about half of lease tract would be mined.	Same as alternative B on mined areas. However, if only north portion mined, magnitude of impact decreased substantially from that of alternative B, because only about half of lease tract would be mined.	Magnitude of positive impact to the economy of Rawlins and Carbon County decreased from that of alternative B if only north portion mined. Same as alternative B if entire tract is mined.	25.6 million tons of coal recovered from north portion. Additional 43.4 million tons of coal recovered from south portion, if mined.
Alternative C1a: Designate as unsuitable for all surface coal mining operations Irwin and others' (1984) Separation Creek and Red Rim study subareas.	Subareas supporting 75 percent of wintering pronghorn population would not be mined. Approximately one-sixth of the critical winter range would be mined (2,800 acres). Reduction of herd prior to mining less than under alternative B, B1, B2, or B3. Carrying capacity of the critical winter range reduced over the short to long term, depending on conditions of the approved mining plan (i.e., whether reclamation occurs as proposed under alternative B, B1, B2, or B3). Magnitude of impact reduced substantially from that of alternative B, B1, B2, or B3, because only about half of lease tract would be mined.	Same as alternative B on mined areas, but magnitude of impact decreased substantially because only about half of lease tract would be mined.	Same as alternative B on mined areas, but magnitude of impact decreased substantially because only about half of lease tract would be mined.	Same as alternative B on mined areas, but magnitude of impact decreased substantially because only about half of lease tract would be mined.	Magnitude of positive impact to the economy of Rawlins and Carbon decreased from that of alternative B.	29 million tons of coal recovered.
Alternative C1b: Designate as unsuitable for all surface coal mining operations the pronghorn critical winter range delineated by Wyoming GFD.	Critical winter range preserved. Reduction of herd prior to mining less than under alternative B, B1, B2, B3, or C1a, because less acreage being mined. Carrying capacity of critical winter range reduced over the short to long term, depending on conditions of the approved mining plan (i.e., whether reclamation occurs as proposed under alternative B, B1, B2, or B3). Magnitude of impact decreased substantially from that of alternative B1, B2, or B3, because only about one-third of lease tract would be mined.	Same as alternative B on mined areas. However, magnitude of impact decreased substantially from that of alternative B, because only about one-third of lease tract would be mined.	Same as alternative B on mined areas. However, magnitude of impact decreased substantially from that of alternative B, because only about one-third of lease tract would be mined.	Same as alternative B on mined areas. However, magnitude impact decreased substantially from that of alternative B, because only about one-third of lease tract would be mined.	Magnitude of positive impact to economy of Rawlins and Carbon County decreased from that of alternative B.	26.9 million tons of coal recovered.
Alternative C1c: Designate as unsuitable for all surface coal mining operations that portion of the pronghorn critical winter range recommended for designation by Wyoming GFD.	Majority of critical winter range preserved. Magnitude of impact increased slightly over that of alternative C1b.	Magnitude of impact increased slightly over that of alternative C1b.	Magnitude of impact increased slightly over that of alternative C1b.	Magnitude of impact increased slightly over that of alternative C1b.	Magnitude of positive - impact to economy of Rawlins and Carbon County decreased from that of alternative B.	34.5 million tons of coal recovered.

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[1] This recoverable coal tonnage estimate does not include estimated recoverable resources underlying BLM's proposed Separation Creek riparian zone (2.1 million tons), golden eagle nest buffer zones (1.0 million tons), and pronghorn (0.3 million tons) no surface occupancy areas.

Implementation of this alternative would preclude any surface coal mining operations within the petition area and any future Federal coal leasing for mining operations unless such designation were terminated by petition (fig. I-4). No impacts to biological resources from surface coal mining activities would occur. Soils, vegetation, surface- and ground-water systems, the other natural systems occuring on or under the 12,426 acres of pronghorn critical winter range within the petition area, and all parts of the existing physical and biological environment described in chapter II would continue to change and evolve as they are now doing unless acted upon by some forces other than coal development.

By 1997, designation of the entire petition area as unsuitable for surface coal mining operations would preclude the creation of 354 jobs either directly or indirectly related to mining. It would also preclude the generation of $92,000 in local property taxes, $8.0 million in State severence taxes, and $3.75 million in Federal royalties. With or without the mine, the population of Carbon County would decline slightly from 1990 through 1995. With the mine, the growth rate of Rawlins from 1993 to 2000 is projected to increase 1.0 percent per year. Without the mine, the growth rate is projected to decline 0.3 percent per year. Although the mine would benefit Rawlins and Carbon County, the stability of the local economy and population is not solely dependent upon the development of the Red Rim petition area.

No Federal coal leases in the immediate vicinity of Red Rim would be affected if the petition is granted. However, implementation of this alternative would preclude the extraction of about 69.0 million tons of recoverable coal in the petition area (about 40.0 million tons of Federal coal and 29.0 million tons that is owned by RME). Although the failure to extract this coal would constitute an unavoidable, potentially long-term impact, the impact would not be irretrievable or irreversible, because action on a future petition (based on development of new data, technology, or reclamation techniques) could rescind the decisions taken by the Secretary under this alternative.

In 1984, Wyoming produced 128 million tons of coal (U.S. Department of Energy, 1985). Because the current coal market is soft, most active coal-producing mines in the State have a greater capacity to produce coal than is currently being tapped. OTA reports that, as of 1981, 208 existing undeveloped coal leases, containing 4.1 billion tons of recoverable reserves, had favorable prospects for development by 1991. The majority of these reserves are located in the Wyoming portion of the Powder River Basin (3.2 billion tons) and in the Uinta region of Utah (0.4 billion tons; Office of Technology Assessment, 1981). Coal from these two regions would most likely supply the same market that coal from the petition area would supply. Therefore, the loss of coal from Red Rim (2.5 million tons per year, 69.0 million tons over the life of the mine) caused by designating the area unsuitable for surface coal mining operations could be compensated for from other mines in the region at costs that would probably be comparable.

Existing and proposed mines in the Green River-Hams Fork region of northwest Colorado and of southcentral and southwest Wyoming, in which Red Rim is located, are projected to produce 60 million tons of coal per year in 1995 (Bureau of Land Management, 1983). In addition, a Federal competitive coal lease sale for this region is anticipated in 1985. If BLM's preferred coal leasing alternative is adopted for this sale, 19 tracts overlying a total of 759.3 million tons of recoverable coal would be offered for lease. If leased, these tracts, in combination with current existing and proposed mines, would produce approximately 83 million tons of coal per year in 1995 (Bureau of Land Management, 1983). According to the Wyoming Department of Economic Planning and Development, coal production in Carbon County will continue to decline through 1987. In 1980, 9.7 million tons of coal were produced in the county; in 1984, 3.45 million tons were produced. In 1988, 1.45 million tons are projected to be mined. Despite these trends, OTA estimates that, by 1990, demand for southern Wyoming coal will be between 42 and 51 million tons per year. The capacity for production from all Federal mines, including those not yet permitted and those anticipated on currently undeveloped leases in the southern Wyoming coal fields, is projected to reach 48 million tons per year by 1991 (Office of Technology Assessment, 1981). Considering the projected coal production from the region, a loss of production from Red Rim (2.5 million tons per year, 69.0 million tons over the life of the mine) owing to an unsuitability designation would not cause a significant impact on regional coal supplies.

National coal consumption should not (within the foreseeable future) be limited by supply constraints caused by designating the petition area as unsuitable for surface coal mining operations. In 1980, DOE reported that the coal industry was then producing at only 87.9 percent of its existing capacity (U.S. Department of Energy, 1980).

B. ALTERNATIVE B: NOT DESIGNATE ANY OF THE PETITION AREA AS UNSUITABLE FOR SURFACE COAL MINING OPERATIONS

Under this alternative, the Secretary of the Interior would find insufficient cause to designate any of the petition area as unsuitable for surface coal mining operations. These decisions would not mean that the Secretary had, conversely, determined petition-area lands to be suitable for surface coal mining operations. The designation process as conceived by Congress is not intended to usurp the permitting and mining plan approval processes, which may also preclude or otherwise control such operations. For mining to take place at Red Rim, OSM (in accordance with SMCRA and NEPA) and Wyoming DEQ (in accordance with WEQA) would have to approve a permit application and issue a permit to mine coal to a permit applicant for the area. In addition, the Secretary of the Interior (in accordance with the Mineral Leasing Act of 1920, as amended) would have to approve a mining plan. (Obviously, prior to OSM, Wyoming DEQ, and the Secretary taking any of these action, BLM would have to lease the proposed Red Rim coal lease tract and application would have to be made to mine it.) Any application for a permit and mining plan to mine Federal coal on Red Rim would be reviewed with assistance from BLM, the Federal surface- and coal-managing agency, and would consider previous environmental analyses of the area (see section IE for a discussion of the BLM coal leasing and land-use planning environmental analyses that have been performed for the Red Rim area), as well as comments and recommendations from other State and Federal agencies and the public. Stipulations to mitigate any adverse impacts could be appended to any permit issued.

Because implementing this alternative would not preclude the possibility of surface coal mining operations in the area, it is assumed that future mining of the petition area would be possible. The probable impacts of surface coal mining operations are discussed in detail in chapter IV of this document.

The most obvious long-term impacts to soils should mining occur under this alternative would be destruction of the soil profiles, loss of soil structure, alteration of pore space, compaction, reduced organic content, and reduction or loss of the viability of native plant propagules because of disturbance or burial in stockpiles. Soils on reclaimed lands might be less resilient than those on undisturbed native range sites; therefore, they could be more susceptible to improper management practices for some unknown period of time after mining and initial reclamation occurred.

Existing vegetation would be destroyed on approximately 12,000 acres (5,600 acres of pronghorn critical winter range) that either overlie the coal at Red Rim, and so would be mined, or would be disturbed by facilities associated with mining. Revegetation of disturbed areas to minimally meet standards mandated by SMCRA would be possible. However, the pattern and diversity of vegetation would be altered over the long term. Prior to issuing a permit, OSM and Wyoming DEQ would establish that a technology adequate to ensure reestablishment over the long term of certain shrubs, such as Wyoming big sagebrush, and of other species necessary to pronghorn during severe winters, exists.

Mining and reclamation at Red Rim would affect pronghorn as follows: (1) habitat would be disturbed and reclaimed in parcels, (2) some areas of critical winter range would be undisturbed and accessible to pronghorn, and (3) reclaimed lands would support some level of pronghorn use 10 to 12 years after they are planted. Initially, the carrying capacity of Red Rim would be reduced; carrying capacity would increase as the area is reclaimed.

A maximum of 4,900 mined and unreclaimed acres would be unavailable to pronghorn during the life of the mine. OSM estimates that a maximum of 4,053 acres of critical winter range, or 23 percent of the total Red Rim critical winter range acreage, would be unreclaimed at any one time.

The reduction of critical winter range acreage is only one of the many mining-related impacts that would affect pronghorn in the Red Rim area. Some of these impacts, such as surveying and drilling, would be temporary, simply causing pronghorn to move until the disturbance is over. Fences, facilities, and pits would impede pronghorn movement, resulting in short-term adverse impacts. Fencing could be designed to permit pronghorn passage, but fence-related hazards could not be entirely eliminated. Numerous secondary impacts, including poaching, road kills, and harassment, would result from the influx and increased activity of people in the area.

If Red Rim were to be mined, the Red Rim pronghorn population would be reduced but not entirely lost. Initially, if the Red Rim tract were leased and an application for a permit to mine it approved, Wyoming GFD would probably reduce its population-management objective for the Baggs Herd to compensate for the anticipated lower carrying capacity on Red Rim. To achieve this new objective, Wyoming GFD would issue additional licenses and open special seasons to increase the number of pronghorn killed by hunters. Over the short term, revenues from license sales and hunt-related spending would increase. Once the new, lower population objective was achieved, Wyoming GFD would set a lower harvest number and, therefore, issue fewer licenses. The annual hunting revenue lost would depend on the difference between the 1985 Wyoming GFD population objective and the new, lower objective set to accommodate Red Rim's lower carrying capacity. This loss of revenue would continue as long as Red Rim's carrying capacity remained below its premining capacity.

Development of the entire petition area for mining would create 354 direct and secondary jobs by 1997. Increased revenues and population owing to mining would constitute positive impacts to Carbon County and Rawlins.

This alternative to not designate any of the petition area as unsuitable for surface coal mining operations comprises three subalternatives (alternatives B1, B2, and B3) that correspond to possible requirements to reclaim Red Rim under each of three reclamation scenarios, which OSM developed to encompass the full range of possible approaches to reclamation of the area (fig. I-5). (See section IVA.) Under alternatives B1, B2, and B3, should the Secretary of the Interior find that mining operations at Red Rim could affect fragile lands or result in significant damage to important natural systems, he could still, at his discretion, approve a mining plan and issue a permit to mine the area. So doing, he could require that the area be reclaimed in accordance with any one of these three reclamation scenarios or with any other reclamation plan deemed appropriate to mitigate the effects of surface coal mining operations on the Red Rim pronghorn critical winter range. The supply of and demand for petition-area coal would not be affected under alternatives B1, B2, and B3, because leasing and mining would not be prohibited under these scenarios. A maximum of 69.0 million tons of coal would be mined and committed irreversibly to power generation or some other uses. (OSM assumes that BLM would stipulate that the successful lessee of the Red Rim tract not create any surface disturbance within the Separation Creek riparian zone, the golden eagle nest buffer zones, and the pornghorn no surface occupancy areas. Given this assumption, an estimated 2.3 million tons of Federal coal and 1.1 million tons of coal owned by RME would be precluded from mining within these areas under each of these three subalternatives.) Alternative B also comprises a fourth subalternative (alternative B4) whereby, before it would be allowed to mine the south portion of the Red Rim coal lease tract, the lessee of the tract would be required to demonstrate that pronghorn critical winter range in the north portion of the tract could be successfully reclaimed (fig. I-6):

1. Alternative B1: Not Designate as Unsuitable for Surface Coal Mining Operations the Entire Petition Area on the Basis that the Area, Including All Pronghorn Critical Winter Range Within It, Would Be Reclaimed to Closely Approach Its Premining Condition

This alternative is analyzed as reclamation scenario 1 in chapter IV. Under it, the Secretary of the Interior would require that the entire petition area, including the pronghorn critical winter range, be reclaimed to closely approach its premining condition. (Note that BLM's no surface occupancy areas would remain undisturbed by surface coal mining operations under this alternative.)

If reclamation under this alternative were required and successfully carried out, the 5,600 acres of pronghorn critical winter range that would be mined would be adversely affected only over the short term; vegetation, soils, topography, and the premining carrying capacity would be restored on the pronghorn critical winter range. Mining and reclamation under this alternative would result in significant, short-term adverse impacts to the Baggs Herd. Wyoming GFD estimates that a maximum of one-third of the Baggs Herd depends upon the petition area for survival. Therefore, assuming that at the time of mining the population of the herd equaled the population-management objective for it and that the objective was 7,200 pronghorn (its current level), 2,400 pronghorn (one-third of 7,200) would depend upon the 19,452-acre Red Rim petition area for survival. OSM estimates that, during a severe winter, pronghorn mortality owing directly to habitat loss due to mining could range from 53 to 1,205 (0.7 to 17 percent of the herd), depending upon the extent of unreclaimed mining disturbance at the time the severe winter occurred. Assuming that a severe winter occurred once every 5 years, approximately 6,800 pronghorn could die over the life of the mine as a direct result of habitat loss. This estimate describes the number of pronghorn that could die over the short term (during the life of the mine) as a direct result of habitat not being available to them owing to ongoing mining and reclamation operations; pronghorn lost in this manner would be additional to those lost from natural causes, irrespective of mining, during severe winters. Even if the number of pronghorn wintering at Red Rim were reduced over the short term, the pronghorn population would return to its premining level as mined areas were returned to their premining carrying capacity.

Several other factors could account for considerable additional pronghorn losses over the short term. Among these are that (1) fences, spoil piles, pits, and other mining-related disturbances and facilities would exclude pronghorn from portions of the critical winter range, exposing them to the elements during severe snowstorms and causing them to overexert themselves to move around barriers and to locate shelter and accessible forage elsewhere; exposure and overexertion would, in turn, lead to increased mortality and decreased reproductive capability; (2) fences could entangle pronghorn trying to cross them or otherwise entrap pronghorn during severe snowstorms; and (3) poaching, road kills, and harassment would increase owing to the influx and increased activity of people in the Red Rim area.

If all factors were optimal, Red Rim could be expected to support some pronghorn use 10 to 12 years after it was regraded and planted. Excluding livestock from reclaimed areas by means provided for under reclamation scenario 1 could be required for from 10 to 12 through 20 years prior to bond release, depending upon precipitation and the extent to which vegetation is reestablished in the area.

Under this alternative, hunt-related revenues would be reduced over the short term.

Certain steep hillslopes within the reclaimed landscape (e.g., those designed to replace existing rimrock or hillslopes now occurring in steep-sided draws) might be unstable over the long term, owing to landsliding and fluvial erosion.

2. Alternative B2: Not Designate as Unsuitable for Surface Coal Mining Operations the Entire Petition Area on the Basis that Half the Area Would Be Reclaimed to Closely Approach Its Premining Condition; the Other Half Would Be Reclaimed Using Standard Reclamation Practices to a Multiple-Use Native Grassland for Livestock Grazing and Wildlife Habitat

This alternative is analyzed as reclamation scenario 2 in chapter IV. Under it, the Secretary of the Interior would require that about 50 percent of the petition area, including part of the pronghorn critical winter range, be reclaimed to closely approach its premining condition. The remainder of the petition area would be reclaimed using standard reclamation practices. OSM developed this subalternative because the Federal and private lands that are dispersed in a checkerboard pattern over the entire petition area could be reclaimed differently according to what the Secretary and Wyoming DEQ require for reclamation on

Federal and private lands, respectively. (Note that BLM's no surface occupancy areas would remain undisturbed under this alternative.)

The carrying capacity for wintering pronghorn would be restored within the short term on approximately half of the mined lands (2,800 acres or 16 percent of the total critical winter range) under this alternative, but within the long term on the other half of the mined lands. Therefore, the long-term, adverse impacts of mining and reclamation on the Baggs Herd under this alternative would be of a magnitude intermediate between the magnitudes of impact under alternatives B1 and B3. Mining and reclamation under this alternative would result in significant, short-term adverse impacts to the Baggs Herd. (See alternative B1 for a description of these impacts.) OSM estimates that, during a severe winter, pronghorn mortality owing directly to habitat loss due to mining could range from 53 to 1,205 (0.7 to 17 percent of the herd), depending upon the extent of unreclaimed mining disturbance at the time the severe winter occurred. Assuming that a severe winter occurred once every 5 years, approximately 6,800 pronghorn could die over the life of the mine as a direct result of habitat loss. Several other factors (fences, spoil piles, pits, and other mining-related disturbances and facilities, as well as poaching, road kills, and harassment) could account for considerable additional pronghorn losses over the short term.

Under this alternative, hunt-related revenues would be reduced over the long term.

3. Alternative B3: Not Designate as Unsuitable for Surface Coal Mining Operations the Entire Petition Area on the Basis that the Area, Including All Pronghorn Critical Winter Range Within It, Would Be Reclaimed Using Standard Reclamation Practices to a Multiple-Use Native Grassland for Livestock Grazing and Wildlife Habitat

This alternative is analyzed as reclamation scenario 3 in chapter IV. Under it, the Secretary of the Interior would require that the entire petition area be reclaimed using standard reclamation practices. (Note that BLM's no surface occupancy areas would remain undisturbed under this alternative.)

The land use for the Red Rim area is currently classified by BLM as "multiple-use;" multiple-use lands include lands used for livestock grazing and wildlife habitat. Typically, such lands are revegetated by way of standard reclamation practices using native grass and shrub species. However, standard reclamation practices would have to be modified to facilitate revegetation of Red Rim under this alternative. Specifically, revegetation would attempt to modify standard soil-hauling and planting techniques, as well as planting configurations, to somewhat increase the suitability of the area for pronghorn use.

If reclamation under this alternative were required and successfully carried out, the 5,600 acres of pronghorn critical winter range that would be mined would be adversely affected over both the short and long term. Vegetation, soils, topography, and the premining carrying capacity for pronghorn would be only partially restored on the pronghorn critical winter range; the carrying capacity of the critical winter range could be reduced for a very long time following mining. The cumulative long-term loss of pronghorn resulting from this long-term reduction of carrying capacity could therefore be large; adverse impacts to the herd from the reduction could be significant. In addition to these long-term impacts, mining and reclamation could result in significant, short-term adverse impacts to the

Baggs Herd. (See alternative B1 for a description of these impacts.) OSM estimates that, during a severe winter, pronghorn mortality owing directly to habitat loss due to mining could range from 53 to 1,205 (0.7 to 17 percent of the herd), depending upon the extent of unreclaimed mining disturbance at the time the severe winter occurred. Assuming that a severe winter occurred once every 5 years, approximately 6,800 pronghorn could die over the life of the mine as the direct result of habitat loss. Several other factors (fences, spoil piles, pits, and other mining-related disturbances and facilities, as well as poaching, road kills, and harassment) could account for considerable additional pronghorn losses over the short term.

Under this alternative, hunting, the primary recreational use of the Red Rim area, and hunt-related revenues would be reduced over both the short and long term.

The effort to reconstruct a stable landscape under reclamation scenario 3 would probably encounter few major difficulties. The postmining topography under this alternative would be less diverse than existing topography; following reclamation, the area's drainage density would be about 15 to 35 percent of its current drainage density. Drainage channels and hillslopes would be designed to maximize their stability.

4. Alternative B4: Not Designate as Unsuitable for Surface Coal Mining Operations the Entire Petition Area But Require the Lessee to Demonstrate the Success of Reclamation of the Pronghorn Critical Winter Range in the North Portion of the Red Rim Coal Lease Tract Before Allowing the South Portion of the Tract to Be Mined

Under this alternative, the Secretary of the Interior would divide the Red Rim coal lease tract into north and south portions (fig. I-6). Assuming that the dividing line between the north and south portions of the tract is located as shown in figure I-6, the north portion of the tract would comprise 9,170.52 acres of land (5,048.68 acres of Federal land, 4,121.84 acres of private land), about 7,257 acres of it pronghorn critical winter range; the south portion would comprise 10,280.98 acres (4,680.21 acres of Federal land, 5,600.77 acres of private land), about 5,169 acres of it pronghorn critical winter range. The Federal coal underlying the south portion of the tract, which would include most of the Separation Creek and Red Rim study subareas delineated by Irwin and others (1984; see alternative C1a), would not be mined until it could be demonstrated that the north portion of the tract could be successfully reclaimed. According to Irwin and others, these subareas represent about 55 percent of the total area they delineated for their study, but support about 76 percent of the wintering pronghorn population at Red Rim. (Note that BLM's no surface occupancy areas would remain undisturbed by surface coal mining operations under this alternative.)

If the north portion of the tract were mined, but reclamation could not be demonstrated to be successful, mining of the south portion would not be allowed. Should the south portion of the tract remain unmined, and land-management practices for this portion remain unchanged, the 5,169 acres of pronghorn critical winter range there would remain undisturbed by surface coal mining operations; the pronghorn carrying capacity for the area would be retained. However, for the north portion of the tract, where reclamation in this case would have proved unsuccessful, the pronghorn carrying capacity would be reduced at least over the long term and perhaps permanently.

If the north portion of the tract were mined, and reclamation were demonstrated to be successful, mining of the south portion would be allowed. Should the south portion of the tract be mined, 5,600 acres (on both the north and south portions of the tract) of the total 17,582 acres of pronghorn critical winter range would be disturbed by mining and mining-related activities. In this case, the impacts to pronghorn and other resources from mining and reclamation would be as described under alternatives B1, B2, and B3, depending upon which reclamation scenario is required by OSM and Wyoming DEQ at the mine-permitting stage.

Under this alternative, 25.6 million tons of coal (14.1 million tons of Federal coal, 11.5 tons of private coal) would be mined in the north portion of the tract. Approximately 43.4 million tons of coal in the south portion of the tract (24.4 million tons of Federal coal, 19.0 million tons of private coal) would be precluded, at least initially, from mining.

C. ALTERNATIVE C: DESIGNATE PARTS OF THE PETITION AREA AS UNSUITABLE FOR SURFACE COAL MINING OPERATIONS

Under this alternative, the Secretary of the Interior would find sufficient cause to designate only certain parts of the petition area as unsuitable for surface coal mining operations. The Secretary's finding of sufficient cause could be based on one of two possible criteria: (1) he may find that surface coal mining operations would affect or significantly damage certain areas comprising fragile lands or important natural systems (Section 522(a)(3)(B) of SMCRA; alternatives C1a, C1b, and C1c) or (2) he may find that these operations would affect certain areas that could not be technologically and economically reclaimed (Section 522(a)(2) of SMCRA; alternative C2). If he bases his finding on the first of these criteria, the Secretary may designate that portion of the petition area to which the finding pertains as unsuitable for surface coal mining operations. If he bases his finding on the second of these criteria, he shall designate the subject portion as unsuitable. Should the Secretary designate any portion of the petition area as unsuitable for surface coal mining operations, the remainder of the petition area would be reclaimed in accordance either with one of the three reclamation scenarios developed by OSM to encompass the full range of possible approaches to reclamation of the area or with another reclamation plan deemed appropriate to mitigate the effects of surface coal mining operations on Red Rim. (See alternatives B1, B2, and B3.)

1. Alternative C1: Designate as Unsuitable for All Surface Coal Mining Operations Those Parts of the Petition Area in which Operations Would Result in Significant Damage to Important Natural Systems

Under this alternative, the Secretary of the Interior would find that certain parts of the petition area are unsuitable for surface coal mining operations on the basis of the criteria of Section 522(a)(3)(B) of SMCRA. SMCRA provides that the regulatory authority may designate an area unsuitable for all or certain types of surface coal mining operations if such operations would affect fragile lands or result in significant damage to important natural systems. OSM has identified three subalternatives subordinate to this alternative:

a. Alternative C1a: Designate as unsuitable for all surface coal mining operations Irwin and others' (1984) Separation Creek and Red Rim study subareas

To determine where pronghorn concentrate at Red Rim, Irwin and others (1984) divided a 24,621-acre study area, which contains the entire 17,582-acre Red Rim pronghorn critical range designated by Wyoming GFD (fig. II-1), into four different subareas (the Red Rim, the Separation Creek, the Central, and the North subareas). According to Irwin and others, the Separation Creek and the Red Rim subareas represent about 55 percent of the total study area but support about 76 percent of the wintering pronghorn population at Red Rim. About half of each of these two subareas falls within the Red Rim petition area (fig. I-7). Under this alternative, the Secretary of the Interior would find that (1) that portion of the petition area coinciding with the Separation Creek and Red Rim study subareas comprises fragile lands or important natural systems and (2) this subject portion is unsuitable for surface coal mining operations. (Note that BLM's no surface occupancy areas, outside the Separation Creek and Red Rim study subareas, would also remain undisturbed by surface coal mining operations under this alternative.)

If the Separation Creek and Red Rim study subareas were designated as unsuitable for surface coal mining operations, a substantial portion of the critical winter range at Red Rim would be protected and its carrying capacity for pronghorn retained. However, such a designation would not protect portions of the range, in the Central and North subareas, that assume greater importance during severe winters (Dr. Larry L. Irwin, University of Wyoming, written communication, January 29, 1985). Despite the designation, losses of pronghorn following severe winters could be significant. The impacts to other biological resources within these designated areas would be as described under alternative A; within those areas not designated as unsuitable, the impacts would be as described under alternative B1, B2, or B3, depending upon which, if any, of the three reclamation scenarios developed by OSM the Secretary specifies for reclamation of these areas, or as described under alternative B, should the Secretary specify some other reclamation plan deemed appropriate to mitigate the effects of surface coal mining operations. Approximately 29 million tons of recoverable coal would be lost to production if the Separation Creek and Red Rim subarea were designated as unsuitable for surface coal mining operations. Approximately 40 million tons of coal would be recovered from that area not designated as unsuitable for surface coal mining operations.

b. Alternative C1b: Designate as unsuitable for all surface coal mining operations the pronghorn critical winter range delineated by Wyoming GFD

Under this alternative, the Secretary of the Interior would find that (1) that portion of the petition area coinciding with the pronghorn critical winter range delineated by Wyoming GFD (fig. I-8) comprises fragile lands or important natural systems and (2) this subject portion is unsuitable for surface coal mining operations. (Note that BLM's no surface occupancy areas, outside the pronghorn critical winter range, would also remain undisturbed by surface coal mining operations under this alternative.)

The Red Rim pronghorn critical winter range is important to the Baggs Herd: an estimated maximum of 2,427 pronghorn have been counted on Red Rim during the winter. Wyoming GFD has estimated that at least one-third of its population-management objective for the Baggs Herd (one-third of 7,200 (the current population-management objective) or 2,400 pronghorn) depend on the Red Rim pronghorn critical winter range (Bureau of Land Management, 1981a). Almost two-thirds of the proposed coal lease tract (64 percent) has been designated pronghorn critical winter range by Wyoming GFD. Approximately 71 percent of this critical winter range (12,426 acres) falls within the petition area.

The entire Red Rim pronghorn critical winter range would be protected from direct surface disturbance by mining under this alternative. Assuming that land-management practices in the area did not change considerably, the carrying capacity of the critical winter range would be retained. However, mining and associated disturbances in areas adjacent to the north and south of the critical winter range could indirectly affect pronghorn using the range.

Approximately 26.9 million tons of coal could be recovered in those areas north and south of the the designated pronghorn critical winter range. Approximately 42.1 million tons of coal underlying the critical winter range would be precluded from recovery.

c. Alternative C1c: Designate as unsuitable for all surface coal mining operations that portion of the pronghorn critical winter range recommended for designation by Wyoming GFD

During the comment period on the petition and draft PED/EIS, Wyoming GFD submitted to Wyoming EQC a proposal it had developed, whereby the Secretary of the Interior and Wyoming EQC would designate only part of that portion of the pronghorn critical winter range delineated by Wyoming GFD and coinciding with the petition area as unsuitable for surface coal mining operations (fig. I-9). (Note that Wyoming GFD developed its proposal before Wyoming EQC had made its decision on the petition as it relates to private lands. See Wyoming GFD's comments in the "Written Statements of Public-Hearing Testimony and Post-Hearing Comments" section of the second volume of this PED/EIS.) Wyoming GFD submitted its proposal in response to a request, made by Wyoming EQC at the public hearing, that that department develop a viable partial-designation alternative. Wyoming GFD's proposal is fivefold. First, Wyoming GFD proposes that that portion of the pronghorn critical winter range shown on figure I-9 be designated as unsuitable for surface coal mining operations. Second, it proposes that, for that portion of the pronghorn critical winter range not designated as unsuitable for surface coal mining operations but still within the petition area, a no surface occupancy stipulation be imposed to protect all sagebrush vegetation types within the subject portion except those that overlie a coal seam. (Coal beds in the petition area dip west-northwest from where they crop out, so that, in effect, all of the land surface within the critical winter range not to be designated as unsuitable for surface coal mining operations overlies a coal seam. Therefore, OSM assumes that Wyoming GFD means sagebrush vegetation types could be disturbed only in mine-pit areas.) Third, Wyoming GFD proposes that the pronghorn no surface occupancy area identified by BLM be maintained and that the mitigation measures suggested in Governor Herschler's letter to BLM, dated July 27, 1981, be adopted. (See the letter from the Office of the Governor to Wyoming EQC in the "Written Comments" section of the second volume of this PED/EIS.) Fourth, it proposes that sagebrush forage lost as the result of mining-related disturbance within the Red Rim critical winter range be compensated for by changing the management policy for grazing in the Muddy Creek critical winter range (approximately 12 to 25 miles southwest of the Red Rim critical winter range) in order to increase that range's forage yield for the Baggs Herd until mined portions of Red Rim are reclaimed. Finally, Wyoming GFD proposes that reclamation restore premining shrub densities within disturbed sagebrush vegetation areas.

Under this alternative, the Secretary would find that (1) that portion of the pronghorn critical winter range recommended for designation by Wyoming GFD comprises fragile lands or important natural systems and (2) this subject portion is unsuitable for surface coal mining operations. (Note that BLM's no surface occupancy areas, outside of this part of the critical winter range recommended for designation by Wyoming GFD, would also remain undisturbed by surface coal mining operations under this alternative.)

If the Secretary adopts this alternative as proposed, he would designate 10,056 acres of the Red Rim pronghorn critical winter range within the proposed coal lease tract as unsuitable for surface coal mining operations; 2,401 acres of critical winter range within the proposed coal lease tract at its extreme north and northwest boundaries, which would be designated as unsuitable for surface coal mining operations under alternative C1b, would not be so designated under this alternative. However, even though the actual acreage designated as unsuitable for surface coal mining operations would be greater under alternative C1b than under this alternative, given the extent to which Wyoming GFD's fivefold proposal would mitigate impacts to pronghorn, the adverse impacts to the Baggs Herd could actually be less under this alternative than under alternative C1b.

Approximately 34.5 million tons of coal could be recovered in those areas north and south of the designated areas. Approximately 34.5 million tons of coal underlying the designated area would be precluded from recovery.

2. Alternative C2: Designate as Unsuitable for All Surface Coal Mining Operations Those Parts of the Petition Area on which Reclamation Is Not Technologically and Economically Feasible

Under this alternative, the Secretary of the Interior would find that certain parts of the petition area are unsuitable for surface coal mining operations on the basis of the criteria set forth in Section 522(a)(2) of SMCRA. SMCRA requires that an area be designated unsuitable for all or certain types of surface coal mining operations if the Secretary finds that reclamation of the area as required by SMCRA is not technologically and economically feasible.

Regarding the technological feasibility of reclamation, OSM has identified no part of the petition area that could not be reclaimed using standard reclamation practices (proposed under reclamation scenario 3). (For the purposes of this document, "standard reclamation practices" means those reclamation techniques that both minimally comply with requirements of the Wyoming State program and are currently being used in the State to reclaim areas disturbed by surface coal mining operations.) Reclamation of the petition area to a multiple-use native grassland for livestock grazing and wildlife habitat would be difficult, owing to severe climatic and environmental conditions in the area (e.g., low precipitation and dessicating winds would hinder revegetation), but achievable.

The petitioners allege that the topography of the mined area must be precisely restored ("microcontoured") and that very high densities of shrubs must be promptly reestablished on the area (approximately proposed under reclamation scenario 1). To reclaim the petition area to closely approach its premining condition would be very difficult, but the magnitude of difficulty would differ from feature to feature within the area. In general, the steeper slopes now supported by indurated bedrock would be most difficult to reconstruct. Although the probability for failure of this type of reclamation over the entire petition area would be much higher than the probability for failure of reclamation using standard reclamation practices, analyses performed by OSM do not conclusively show that this type of reclamation is technologically infeasible.

Regarding the economic feasibility of reclamation, OSM found that reclamation under reclamation scenarios 1, 2, and 3 would, on the average, cost approximately $41,000, $32,000, and $22,000 per acre to perform. These reclamation costs are comparable with costs to reclaim other surface coal mines in Wyoming. Therefore, the cost of reclaiming Red Rim would not be prohibitively high; reclamation of the area would not be economically infeasible.

D. ALTERNATIVE D: DESIGNATE THE ENTIRE PETITION AREA AS UNSUITABLE FOR SURFACE COAL MINING, BUT ALLOW UNDERGROUND MINING

Under this alternative, the Secretary of the Interior would find that the petition area is unsuitable for surface coal mining but suitable for underground mining. BLM has determined that the proposed Red Rim coal lease tract has moderate potential for subsurface mining (Bureau of Land Management, 1982). However, underground mining does not appear likely in the foreseeable future, because (1) the expense of mining the subbituminous coal resources at Red Rim would not be sufficiently offset by profits from that venture (only 50 to 55 percent of the in-place coal resource could be mined; U.S. Geological Survey, 1978); (2) significant health and safety problems could result from mining these particular steeply dipping multiple seams of coal; and (3) underground mining these coal seams could cause extensive surface subsidence, which could be environmentally unacceptable to OSM. Therefore, no specific underground mining alternative was considered in this document.

Should underground mining occur at Red Rim, the impacts that would result to the environment are predictable in general terms. Surface disturbances associated with an underground mining operation would occur where surface facilities (e.g., areas for portals, coal handling and stockpiling, equipment storage and maintenance, offices, roads, and a railroad spur) were located. Although the impacts to pronghorn, topography, vegetation, and soils resulting from the construction and maintenance of these surface facilities would be similar to those resulting from surface-mining the area, the overall areal extent of these disturbances and the magnitude of impacts owing to them would be less than would occur if Red Rim were surface-mined. In addition, subsidence resulting from underground mining could adversely affect both surface and subsurface resources. Irregular subsidence would result in surface damage, such as surface fissures, sinkholes, cave-ins, and other irregular lowering of the land surface. Any large-scale, massive alteration of the topography, which is a key element of the pronghorn critical winter range, could have an adverse impact on the carrying capacity of the pronghorn critical winter range. Also, vertical subsidence would alter surface- and ground-water drainage patterns, allowing water and air to enter the underground works. Spontaneous combustion of the coal seam could result, causing air and water pollution.

E. ALTERNATIVE E: NO ACTION

Under this alternative, the Secretary of the Interior would make no findings with respect to the Red Rim unsuitability petition; he would make no decision to designate or not designate all or any part of the petition area as unsuitable for all or certain types of surface coal mining operations.

Because this document not only evaluates the Red Rim petition (by way of a PED) but constitutes an EIS, NEPA mandates that it address a "no-action alternative." OSM evaluated the no-action alternative and determined it not to be reasonable, because the petitioners have fulfilled the requirements of Federal and State regulations and have filed a complete petition to designate the subject lands as unsuitable for surface coal mining operations. Therefore, a decision by the Secretary of the Interior regarding the petition is required by law. However, because the impacts to the human environment of implementing the no-action alternative would be the same as those of not designating any of the petition area as unsuitable for surface coal mining operations (alternative B), for the purpose of the PED/EIS these alternatives are considered equivalent. For this reason, the no-action alternative is not analyzed further. (Note that a decision to not designate all or any part of a petition area as unsuitable for all or certain types of surface coal mining operations would not mean that such lands have been, conversely, determined as suitable for such operations. That is, implementing either alternative B or the no-action alternative would not mean that surface coal mining operations within the petition area would necessarily occur. Mining would occur only if the coal were leased and if all appropriate mining permits and authorizations were obtained from State, local, and Federal agencies.)

CHAPTER VI

PUBLIC PARTICIPATION AND REVIEW

This PED/EIS was prepared by OSM. The conclusions it reaches take account of information contained in the National Wildlife Federation/Wyoming Wildlife Federation Red Rim unsuitability petition; the petitioners' supporting documents; reports and studies developed by RME; BLM's Red Rim land-use planning documents; intervention petitions filed by landowner Taylor Lawrence (received by OSM on March 8, 1983) and by RME (received by OSM on December 1, 1983; see section IB for a summary of the intervention petitions' major contentions); a response by National Wildlife Federation to Taylor Lawrence's intervention petition (received by OSM on April 18, 1983); public comments on the petition and draft PED/EIS (received by OSM, Wyoming EQC, and/or Wyoming DEQ); and material gathered by OSM or submitted to it from other sources. This information was gathered and analyzed, and the analyses reviewed, so that the conclusions reached in the PED/EIS would be as accurate as possible.

Public notice of acceptance of the complete petition was given in the January 5, 1983, Federal Register (48 F.R. 523) and in the January 14 and 17, 1983, Casper Star-Tribune and January 14 and 18, 1983, Rawlins Daily Times newspapers. Personal notice of acceptance was also given by mail to all persons or parties with identifiable ownership interest in the petition area.

A notice of intent to prepare a draft PED/EIS, including a request for public participation in the determination of the scope of the issues and in the identification of significant issues, was published in the June 29, 1983, Federal Register (48 F.R. 29961), and in the July 2, 1983, Casper Star-Tribune and June 30, 1983, Rawlins Daily Times newspapers. OSM received two comment letters by the end of the scoping period on July 29, 1983. OSM modified the alternatives presented in the draft PED/EIS based on the comments in one of these letters; it considered the comments in the other letter, which discussed the current socioeconomic conditions in Rawlins, Wyoming, throughout preparation of the PED/EIS. All comments on the petition in the Red Rim public record (Taylor Lawrence's intervention petition, the petitioners' response to that intervention petition, all comments received in response to the notice of acceptance of a complete petition (48 F.R. 29961)) were used in determining the scope of the draft PED/EIS.

On October 19, 1983, the draft PED/EIS document was mailed to all parties who had expressed an interest in the petition. Notice of availability of the draft PED/EIS, of the opening of a public comment period on the petition and draft PED/EIS, which was to close December 23, 1983, and of rescheduling of a public hearing for December 6, 1983, was published in the October 20, 1983, Federal Register (48 F.R. 48724) and in November 1983 in the Rawlins Daily Times and Casper Star-Tribune newspapers.

Notice of postponement of the public hearing and of extension of the public comment period until further notice was published in the January 4, 1984, Federal Register (49 F.R. 521). Notice of rescheduling of the hearing until April 9, 1984, and of extension of the public comment period until April 20, 1984, was published in the March 5, 1984, Federal Register (49 F.R. 8092). Notice of indefinite postponement of the hearing and of extenson of the public comment period was published in the April 4, 1984, Federal Register (49 F.R. 13440).

OSM and Wyoming EQC held a joint public hearing on the petition and draft PED/EIS on January 23 and 24, 1985, in Rawlins, Wyoming. Notice of the hearing was published in the December 19, 1984, Federal Register (49 F.R. 49368) and in the December 19 and 26, 1984, and January 16, 1985, Casper Star-Tribune and Rawlins Daily Times newspapers. Written notice of the hearing was given to BLM, the surface-managing agency; to local, State, and Federal agencies that had expressed an interest in the decision on the petition; to the petitioners and intervenors; to any person (known to OSM or Wyoming DEQ) with an ownership or other interest in the petition area; and to all other parties who had expressed in writing an interest in the petition. Details regarding procedures for the hearing were provided in these public notices.

Thirty-three persons presented testimony at the public hearing, which lasted from about 9:35 a.m. to 6:45 p.m. on January 23, 1985, and from about 9 a.m. to 3:35 p.m. on January 24, 1985. The transcript of the hearing is 469 pages long. Together with their oral testimony, most speakers submitted written statements and other material for the record. After the public hearing, some of the speakers also submitted written comments to OSM, Wyoming EQC, or Wyoming DEQ to clarify or supplement their public-hearing testimony, to refute the testimony of other persons who had testified, or to provide information requested by OSM and/or Wyoming EQC at the hearing.

In addition to these written comments, OSM, Wyoming EQC, or Wyoming DEQ also received 101 comment letters, submitted by 76 persons, during the comment period. The second volume of this PED/EIS contains OSM's responses to all individual oral and written comments it, Wyoming EQC, or Wyoming DEQ received.

The draft PED/EIS was subjected to an approximately 15-month public-comment and review period. Written comments on the petition and draft document were accepted at the OSM, Wyoming EQC, and Wyoming DEQ offices until 5 p.m., February 7, 1985.

This final PED/EIS is being mailed to all parties who have expressed an interest in the petition. A public record of all events relating to the Red Rim unsuitability petition process, which includes a copy of the final PED/EIS, is available for public review at the following locations:

OSM, Western Technical Center, Brooks Towers, 1020 -15th Street, Denver, Colorado 80202;

Wyoming DEQ, Herschler Buildling, 3d Floor, 122 West 25th Street, Cheyenne, Wyoming 82002;

BLM District Office, 1300 North 3d Street, Rawlins, Wyoming 82301; and

Office of the County Clerk, Carbon County Courthouse, 5th and Spruce Streets, Rawlins, Wyoming 82301.

CHAPTER VII

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[1] On May 22, 1985, Wyoming EQC decided by a vote of four to three not to designate any of the private lands within the petition area as unsuitable for surface coal mining operations. In consequence, Wyoming DEQ withdrew from participating in the preparation of this final PED/EIS, for which OSM then assumed full responsibility. To acknowledge their contribution (principally to the draft PED/EIS), OSM has listed Wyoming DEQ staff members who participated in preparation of the draft PED/EIS, and the final PED/EIS until Wyoming EQC issued its decision, as preparers and contributors here.

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CHAPTER VIII

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APPENDIX A

UNSUITABILITY PETITION AND SUPPLEMENT

[illegible] National [illegible]

U.S. [illegible]

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NATIONAL WILDLIFE FEDERATION

ROBERT J. GOLTEN
COUNSEL

NATURAL RESOURCE CLINIC
FLEMING LAW BUILDING
BOULDER, COLORADO 80309
303 492-6552

7 May 1982

Wyoming Department of
Environmental Quality
Equality State Bank Building
401 West 19th Street
Cheyenne, WY 82002

Attn: Walter C. Ackerman, Land Quality Administrator

Gentlepersons:

We transmit an original and one copy of a Petition for Designation as Unsuitable for Surface Coal Mining Operations a 10,160-acre area southwest of Rawlins known as "Red Rim." The area in question is critical habitat for a sub-herd of pronghorn antelope (part of the Baggs herd), and restoration after mining to its present condition and use does not appear to be "technologically and economically" feasible. Our petition, accordingly, is two-pronged, based on criteria Wyo. Stat. § 35-11-425(b)(ii)(B) (Supp. 1981) and Wyo. Stat. § 35-11-425(b)(i)(Supp. 1981).

Yours truly,

Robert Golten /dh

Robert J. Golten, Counsel

dh

Enclosures

cc: Office of Surface Mining, Mills, Wyoming
Rocky Mountain Energy, Inc.

To: WYOMING ENVIRONMENTAL QUALITY COUNCIL

IN RE THE MATTER OF "RED RIM"

NATIONAL WILDLIFE FEDERATION

and

WYOMING WILDLIFE FEDERATION

PETITION FOR DESIGNATION AS UNSUITABLE FOR SURFACE COAL MINING OPERATIONS

Howard Geduldig, Legal Intern
Sharon Nelson, Legal Intern
Robert Golten, Counsel
NATIONAL WILDLIFE FEDERATION
Natural Resource Clinic
Fleming Law Building, Box 401
Boulder, CO 80309
(303) 492-6552

Pursuant to Wyo. Stat. § 35-11-425 (Supp. 1981), we respectfully submit the following petition and materials in support of that petition to have the non-federal, private lands in the proposed Red Rim coal lease tract designated unsuitable for all types of surface coal mining.

1. Petitioners' Name, Address, and Telephone Number.

National Wildlife Federation
Natural Resource Clinic
Fleming Law Building, Box 401
Boulder, CO 80309
(303) 492-6552

Wyoming Wildlife Federation
Box 4026
Casper, WY 82604

2. Identification of Petitioners' Interest Which may be Adversely Affected.

The National Wildlife Federation (NWF) is a private conservation organization with over 4.5 million members and supporters nationwide, 3,000 of whom reside in Wyoming. The Wyoming Wildlife Federation (WWF), a state affiliate of NWF, has approximately 1,500 members in the State. Both organizations have an interest in the wise management of the nation's natural resources, and in the protection of wildlife species important to the nation and the State of Wyoming.

3. Description of the Boundaries of the Area Covered by the Petition.

The private, non-federal lands in the proposed Red Rim coal lease tract in Carbon and Sweetwater Counties, Wyoming are listed in Table 1.

Table 1

Private, Non-federal Lands on the Proposed Red Rim Coal Lease Tract

Location	Acres
T. 19 N., R. 90 W.	
sec. 3: NW¼	160
sec. 5	640
sec. 7: E½, SW¼, SE¼NW¼	520
sec. 9: NW¼	160
sec. 17: W½	320
sec. 19	640
T. 19 N., R. 91 W.	
sec. 13: E½E½, SW¼SE¼	200
sec. 25	640
T. 20 N., R. 89 W.	
sec. 5	640
sec. 7	640
sec. 9: NW¼	160
sec. 17: NW¼	160
sec. 19: W½	320
T. 20 N., R. 90 W.	
sec. 1: SE¼, E½NE¼, SW¼NE¼	280
sec. 11: E½SE¼, SW¼SE¼	120
sec. 13	640
sec. 23	640
sec. 25	640
sec. 27	640
sec. 33	640
sec. 35: N½	320
T. 21 N., R. 89 W.	
sec. 23: SE¼SE¼	40
sec. 25: W½, NW¼NE¼	360
sec. 35	640
TOTAL	10,160

Source: Geological Survey, Conservation Division, 1979.

4. Criteria on Which the Proposed Designation Rests.

a. Pursuant to 30 U.S.C. § 1272(a)(3)(B), 30 C.F.R. § 762.11(b) (1981), and Wyo. Stat. § 35-11-425(b)(ii)(B)(Supp. 1981) upon petition, the Wyoming Environmental Quality Council (EQC) may designate an area as unsuitable for certain types of surface coal mining operations on "fragile lands"--if the operations could significantly damage important scientific or aesthetic values or natural systems.

Surface coal mining operations will have a detrimental impact on "fragile lands". The operations could result in significant damage to valuable wildlife habitat, including critical winter range for pronghorn antelope.

b. Pursuant to 30 U.S.C. § 1272(a)(2), 30 C.F.R. § 762.11(a) (1981), and Wyo. Stat. § 35-11-425(b)(i)(Supp. 1981) upon petition, an area shall be designated by the EQC as unsuitable for all or certain types of surface coal mining operations if the EQC determines that reclamation is not technologically and economically feasible under the Surface Mining Control and Reclamation Act of 1977 (30 U.S.C. §§ 1201, et seq.) and an approved state regulatory program (which Wyoming has). See 30 C.F.R. § 211.77(a) (1981).

Reclamation so as to preserve and enhance present uses on Red Rim would not be technologically and economically feasible.

5. Facts Supporting the Criteria.

a. Surface coal mining operations will adversely affect fragile land which is valuable habitat for pronghorn antelope.

EQC has been granted primary regulatory authority to designate appropriate tracts of non-federal land as unsuitable for surface coal mining operations (30 U.S.C. § 1272(a)(1) and 30 C.F.R. § 211.77(a)). Those areas that are appropriate for such designation include "fragile . . . lands in which such operations could result in significant damage to . . . scientific, and esthetic values and natural systems." (30 U.S.C. § 1272(a)(3)(B)).

Red Rim is critical winter range for pronghorn. Surface coal mining operations on Red Rim would do significant damage to both this habitat and the pronghorn herd relying on it.

Examples of "fragile lands" are provided in 30 C.F.R. § 762.5 (1981) and Wyoming DEQ Land Quality Division Rules and Regulations Chapter XVIII, Section 1(2)(1981), and include "valuable habitats for fish and wildlife." Critical winter habitat for pronghorn is clearly valuable--indeed essential--habitat for wildlife. As such, Red Rim qualifies as statutory "fragile lands," to which the EQC may apply its authority. Failure to use its power to designate non-federal sections of Red Rim as unsuitable for surface coal mining under the circumstances here presented would be an abuse of discretion.

"Critical wildlife habitat" is defined by the Wyoming Game and Fish Department (GFD) as "that habitat that is in the shortest supply and is the limiting resource for the entire herd unit."[1] Traditionally between 1,200 and 2,800 pronghorn winter on Red Rim[2] because their essential needs (food and shelter) are provided there. Thus, the GFD, in conjunction with the Bureau of Land Management (BLM), has designated 15,200 acres of land on Red Rim, part federal and part non-federal, as "critical wildlife habitat" for a significant portion of the Baggs pronghorn herd.[3]

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[1] Affidavit of Dale Strickland (Appendix 6). See also BLM memorandum dated 6/13/81 (Appendix 7), p. 15 (hereinafter "BLM memorandum").

[2] Affidavits of Dave Moody (Appendix 5) and Larry Irwin (Appendix 4).

Red Rim's importance as critical wildlife habitat results from a combination of unique topography and abundance of forage, especially big sagebrush.[4] It is believed that pronghorn traditionally winter on Red Rim, in part because its uplifted, vegetated surfaces are almost always blown clear by winds, while surrounding areas are, and remain, covered with snow.[5] Its many narrow draws serve two complementary purposes. They provide pronghorn with protection from the strong winds.[6] At the same time, because wind-driven snow collects in them, a relatively high-moisture micro-climate is created in these draws. Predictably, greater densities of forage are found in the draws than elsewhere in the vicinity.[7] The high density of sagebrush on Red Rim is extremely important in meeting the essential winter dietary needs of this portion of the Baggs pronghorn herd. Up to 95% of the winter diet of these pronghorn is shrubs, primarily big sagebrush.[8]

Surface coal mining operations would clearly alter this unusual topographic-vegetative relationship, drastically reducing Red Rim's unique ability to meet the essential needs of wintering pronghorn.

The proposed Red Rim lease tract includes 10,160 acres of non-federal land, more than 75% of which has been designated by GFD as critical wildlife habitat.[9] According to Rocky Mountain Energy Company (RME) personnel, approximately 3,750 acres[10] of the Red Rim coal lease tract will actually be mined. On the other hand, GFD personnel estimate that approximately 9,120 acres of the designated critical wildlife habitat on federal and non-federal land (i.e., 60%[11] of 15,200 acres) would be mined. Neither the 3,750-acre figure nor the 9,120-acre figure includes an estimate of the acreage to be affected by all ancillary activities that will further reduce Red Rim's availability as winter pronghorn habitat. Since reclamation of Red Rim (including that contemplated during the life of the mining operations) appears to be technologically and economically infeasible (see section b., below) critical habitat available to pronghorn would be greatly diminished in size and quality during the life of the mining operation and for the foreseeable future.

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[3] Affidavit of Dave Moody (Appendix 5); personal communication of Harry Harju. See also BLM memorandum, pp. 9-11.

[4] Affidavits of Harry Harju (Appendix 3), Larry Irwin, Dave Moody, and Dale Strickland.

[5] Affidavits of Harry Harju, Dave Moody, and Dale Strickland; BLM memorandum, pp. 8-9.

[6] Affidavits of Larry Irwin, Dave Moody, and Dale Strickland; L. Irwin, Impact of Coal Mining Activities on Pronghorn Antelope in the Red Rim-China Butte Area, Wyoming, 1981 Annual Report 11, Department of Zoology and Physiology, University of Wyoming, Laramie, WY 82071; BLM memorandum, pp. 8-9.

[7] Personal communication with Harry Harju.

[8] Affidavit of Dale Strickland. See also BLM memorandum, p. 15, and L. Irwin, supra, note 6, at 8-10.

[9] Personal communication with Harry Harju. Due to the checkerboard pattern of federal land grants to railroads, a similar amount of federal land, in excess of 75% of which is critical wildlife habitat, would be included in the coal lease tract.

[10] RME computes the maximum number of acres of disturbance at any one time, taking ongoing reclamation into consideration, to be 1,530 acres. In arriving at that figure, RME assumes that total reclamation is feasible and that shrub productivity of 40% of pre-mining levels can be accomplished within six years, and of 100% of pre-mining levels by the 20th year after disturbance. (Personal communication with Elroy Taylor of RME.)

In contrast, the BLM estimates that the maximum number of acres of disturbance may be as much as 4,200 to 6,300 acres of crucial winter range. (BLM memorandum, p. 37.)

The pronghorn wintering on Red Rim would be most likely to remain there during severe winters because storm patterns create a situation where Red Rim is the only accessible habitat providing their essential needs.[12] Even if alternative winter habitats could be reached by these pronghorn (e.g., during a mild winter), their traditional ties to Red Rim would make abandoning this particular habitat unlikely.[13]

Thus, mining operations would lead to crowding of the animals on Red Rim. The result would be large-scale nutritive deficiency which would lead to decreased survival of wintering pronghorn and reduced reproductive rates. During severe winters, herd loss would be directly proportional to habitat loss,[14] e.g., if 35% of Red Rim was disturbed, predictably 420 to 980 pronghorn would be lost.[15] There would also be a cumulative loss of progeny over the life of the mine.[16]

This threatened loss of pronghorn is unacceptable. Pronghorn are a comparatively unique species. They are among the fastest mammals, attaining speeds of about 55 miles per hour. Found primarily in the State of Wyoming, the pronghorn as a species is one of the few in the world that constitutes the entirety of a biological family. Thus, any threat to this species would pose a danger to the whole family. In addition, the group wintering on Red Rim is scientifically unique, due to their unusual fidelity to a single habitat.[17] The loss of these pronghorn would be tragic, both economically[18] and scientifically. Since the effects of the significant disturbance and permanent alteration of a large portion of their wintering area are at best predictably adverse, and at worst disastrous, such activities should not be permitted.

It is the policy and purpose of the Wyoming Environmental Quality Act (Wyo. Stat. §§ 35-11-101, et seq. (Supp. 1981)) to enable the state to plan the preservation and enhancement of land resources of the state. Wyo. Stat. § 35-11-102 (Supp. 1981). Pronghorn habitat is a resource of great value to the State of Wyoming. Therefore, the EQC should use its discretionary power to protect this critical habitat by designating all non-federal land on Red Rim as unsuitable for surface coal mining operations.

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[11] Affidavit of Dave Moody.

[12] Affidavit of Dave Moody. See also BLM memorandum, p. 11.

[13] Affidavit of Harry Harju. See also BLM memorandum, p. 38.

[14] Affidavit of Dale Strickland. See also BLM memorandum, p. 15.

[15] BLM memorandum, p. 38.

[16] BLM memorandum, p. 39.

[17] Personal communication with Dave Moody.

[18] GFD's most recent report indicates that in 1980 the Baggs herd produced $71,624 in license fees to the GFD, and $350,668 in hunter revenue to local businesses.

b. Reclamation is not technologically and economically feasible under the Surface Mining Control and Reclamation Act of 1977 (30 U.S.C. §§ 1201, et seq.).

According to Federal and State law, the EQC is required to designate non-federal lands on Red Rim as unsuitable for surface coal mining operations upon a showing that reclamation is not technologically and economically feasible. 30 U.S.C. § 1272(a)(2), 30 C.F.R. § 762.11(a)(1981), and Wyo. Stat. § 35-11-425(b)(i)(Supp. 1981). The Surface Mining Control and Reclamation Act of 1977 (SMCRA), 30 U.S.C. § 1265(b)(2), and the Wyoming Environmental Quality Act, Wyo. Stat.'§ 35-11-402(a)(i) (Supp. 1981), establish the required standards applicable to reclamation operations. At a minimum, reclamation must restore the affected land to a condition capable of supporting its highest pre-mining uses which, in light of Red Rim's designation as critical wildlife habitat for pronghorn, includes critical winter range for pronghorn. Reclamation of Red Rim would require restoration of the land's ability to provide the essential needs of the same number of wintering pronghorn, i.e., reestablishment of critical winter range. Therefore, reclamation would require restoration of both pre-mining drainage patterns (to provide the numerous small draws offering essential shelter to pronghorn and increased moisture to vegetation) and pre-mining vegetative patterns (to provide the essential dietary needs of pronghorn) as discussed above in section a. To preclude decimation of the 1,200 to 2,800 pronghorn herd wintering on Red Rim (a substantial portion of the Baggs herd), prompt restoration of this critical winter range to its former carrying capacity would be essential.

Given these parameters and the state of today's technology, reclamation on Red Rim does not appear to be technologically and economically feasible. In the absence of documentation to the contrary--and, as far as we know, there is none--designation of Red Rim as unsuitable for surface coal mining operations is mandated.

(i) Topographic restoration.

Restoration to the pre-mining use of pronghorn winter range of the same or better than pre-mining quality would require a program of micro-contouring to recreate drainage patterns and rebuild the backbone-like configuration of the primary and secondary ridges that presently exist and are necessary to provide the animals' winter needs.[19] To accomplish such a micro-contouring program, accurate maps of the land must first be prepared before disturbance. After disturbance, bulldozers must reposition the overburden and topsoil in conformity with these maps. Until new vegetation took hold, substantial repair and maintenance would be required to preserve the restored draws and replaced topsoil.[20]

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[19] Personal communication with Harry Harju. See also BLM memorandum, p. 39.

Failure to achieve this topographic restoration would result in less winter forage for two reasons. First, absent secondary ridges, less exposed vegetation would be available during snowy periods (the secondary ridges are windswept in the same manner as the main ridge). Also, the draws formed between the ridges protect growing forage and hold moisture to encourage more profuse growth of forage.[21]

Furthermore, restoration to a smoother, rolling topography would cause greater exposure of the pronghorns to the adverse effects of bitter winter winds. This would create a need for greater quantities of forage, as the animals would have to eat more to maintain their body heat. If they congregated in the undisturbed draws, greater stress to the herd would result, and over-use of the vegetation in those areas would probably occur.[22]

Micro-contouring attempted in reclamation of the large coal mines near Colstrip, Montana, has not proven entirely successful. Soil stabilization on the sloping sides of the draws continues to be a problem.[23] Because regeneration of soil-stabilizing vegetation would predictably take longer on Red Rim than at Colstrip (because of Red Rim's lower precipitation, greater winds, and lower temperatures),[24] it is anticipated that topographic restoration would be even less successful on Red Rim than that experienced at Colstrip. In short, we see no evidence to support the proposition that pre-mining topographic features could be successfully reestablished over the long term on Red Rim.[25]

(ii) Vegetative restoration.

Since critical winters occur unpredictably on the average of once every ten years, it would be essential to the herd that critical winter range be returned to optimum vegetative densities promptly after disturbance. A twenty to forty year restoration plan is unacceptable, as it would unavoidably result in (a) disastrous cumulative impacts, and (b) serious annual losses during critical winters.

Two potential methods have been suggested to accomplish restoration. One involves transplanting individual mature shrubs with a tree spade, combined with a seeding program to reestablish other components of the natural vegetative community. The second involves a program of "dry-land sodding." We find no evidence that either method is economically feasible to restore Red Rim as critical wildlife habitat for pronghorn within a reasonable time, i.e., before the first critical winter.

(A) Transplanting individual sagebrush.

Transplanting individual sagebrush with a tree spade was attempted by RME. Their program provided for planting shrubs at low densities (approximately 10% of the current mean density on Red Rim[26]) in the hope that these plants would provide a nucleus for subsequent additional shrub regeneration.

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[20] Affidavit of Don Calhoun (Appendix 1).

[21] Personal communication with Harry Harju.

[22] Id.

[23] Affidavit of Don Calhoun.

[24] Affidavit of Ed Depuit (Appendix 2).

[25] RME reportedly has no plans to undertake a post-mining program of micro-contouring due to the difficulty of recontouring with unconsolidated material in an arid, windy climate. Further, reclamation of the small draws so critical to the pronghorns' survival would not be in keeping with EQC's purported policy not to approve any plan for reclamation that calls for slopes greater than 3:1.

RME's test plots were located on the most receptive of Red Rim's terrain, i.e., on a relatively level area with comparatively deep topsoil. These test plots were exposed to unusually favorable moisture conditions created by two extraordinarily wet springs. Further, the shrubs were transplanted into recently disturbed land with fresh topsoil, within minutes of the shrubs' removal from adjacent ground. Clearly, their survival fails to reflect the real obstacles to reclamation and fails to demonstrate adequately reclamation feasibility under normal conditions.[27]

In the absence of the numerous draws presently on Red Rim, restoration of the current diversity and density of vegetation would not be possible.[28] Even if successful, however, regeneration to current densities would be very slow, and aggravated by low annual precipitation,[29] averaging 9.5 inches per year. Under the best of circumstances, it would not restore all of the land to its original vegetative quality in less than 20 years after cessation of the projected 25-year mine life, i.e., in less than 45 years total.[30] GFD doubts that original vegetative quality could be restored in less than 40 years after cessation of the projected 25-year mine life, i.e., in less than 65 years total.[31] By that time, the pronghorn life traditionally relying on Red Rim would have been extinguished.[32]

Transplanting individual mature sagebrush plants with a tree spade at the current, pre-mining shrub densities on Red Rim might result in adequate revegetation of the critical wildlife habitat for a short period, i.e., until a few sequential years of precipitation at normal or below normal levels. Sagebrush densities on Red Rim are diverse, currently ranging from 800 plants to 7,700 plants per acre, with an average of about 4,000 plants per acre (almost ten times the transplant density achieved by RME on its test plots).[33] Although the difficulty in achieving plant proliferation might be avoided by this method, costs would be astronomical. See "restoration costs," below. Furthermore, without micro-contouring sufficient moisture would not be available to sustain pre-mining shrub densities over the long run.[34]

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[26] Personal communication with Elroy Taylor and Larry Irwin.

[27] Affidavit of Dave Moody; personal communication with Harry Harju.

[28] Personal communication with Harry Harju. See also Rules and Regulations, Wyo. Dept. of Environmental Quality, Land Quality Division, Chapter IV, Sec. 3, d(6)(a) (1981), requiring revegetation to at least pre-mining density where wildlife is part of the post-mining use.

[29] Affidavit of Ed Deputt.

[30] Personal communication with Elroy Taylor.

[31] Affidavit of Dave Moody.

[32] Fencing to protect growing plants for at least six years would be a necessity (personal communication with Harry Harju). Fenced areas would be totally unavailable to pronghorn for forage, and fences might create impediments to movement through the area.

[33] Personal communication with Larry Irwin.

[34] Personal communication with Harry Harju.

(B) Dry-land sodding.

"Dry-land sodding" could be an effective method of revegetation. With this method individual "pads," i.e., sagebrush and sagebrush-grass types of vegetation already growing elsewhere on a parcel of soil measuring approximately 8-feet long by 5-feet wide by 1-foot deep, are uprooted and placed contiguously across the prepared post-mining surface (see "topographic restoration," above). Sagebrush transplanted in this manner are limited in height to about 6 inches. Larger plants would not survive because of damage to their tap roots in the initial uprooting and transport of the 1-foot-thick dry-land sodding pads. It would take at least another 15 years before transplanted 6-inch-high sagebrush plants would reach the height of sagebrush (15 inches to 5 feet) currently available to pronghorn on Red Rim.[35]

* * *

Of these two methods, only a program of transplanting sagebrush at current densities on Red Rim (approximately 4,000 shrubs per acre) would provide adequate revegetation of critical wildlife habitat in a reasonable period of time. Even so, survival of the vegetation at pre-mining densities is most unlikely without an initial program of micro-contouring as discussed in subsection a, above.

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[35] Affidavit of Don Calhoun.

(iii) Restoration costs.

Assuming RME will attempt micro-contouring, and success is possible on Red Rim, the estimated cost of restoration to simulate pre-mining drainage patterns ranges from $6,000 to $7,500 per acre. See Table 2, "Topographic Restoration."[36]

RME reported costs of $15 per transplant on their test plots. At approximately 435 transplants per acre, their program would cost $6,424 per acre for restoration of the vegetation. See Table 2, "Program" 1.a.

At $25 to $70 per transplant, which are figures cited by other experts,[37] and with an average of 4,000 plants per acre, a transplanting program designed to achieve current shrub densities on Red Rim in a relatively short time period, would cost from $100,000 to $120,000 per acre. See Table 2, "Program" 1.b.

At $25 to $50 per "pad," contiguous dry-land sodding would cost from $27,000 to $55,000 per acre. See Table 2, "Program" 2.[38]

As urged earlier, it is questionable whether the technology exists to achieve the statutory requirements of reclamation on Red Rim, regardless of cost. There is no documentation to suggest it does. However, it is even more questionable whether industry could demonstrate that revenue would be sufficient to cover

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[36] Id.

[37] Id.

[38] Id.

Table 2

Proposed Reclamation Costs per Acre

Program	Topographic Restoration	Vegetative Restoration	Total of Topographic and Vegetative Restoration
1. Transplant with tree spade:			
a. RME Study: 425 shrubs/acre (approximately 10% current mean density)	$6,000-7,500	$ 6,525	$ 12,525- 14,025
b. Hypothetical program to plant an average of 4,000 shrubs/acre (approximate current mean density)	6,000-7,500	100,000-120,000	106,000-127,500
2. Dry-land sodding	6,000-7,500	27,000-55,000	33,000- 62,500

Note: All figures except the RME Study estimates are based on costs as of three years ago. The RME estimates are based on costs as of two years ago. Actual costs would be significantly higher now due to inflation.

expenditures necessary[39] to effectively reclaim critical wildlife habitat for pronghorn on an ongoing basis, i.e., to ensure adequate available habitat in the event of a critical winter.

Therefore, because Red Rim cannot by means of any known technology be reclaimed to its present highest use without incredibly high cost, all non-federal land on Red Rim should be designated as unsuitable for all types of surface coal mining operations.

6. Specific Identification of Sources.

a. Don Calhoun, Owner of D&C Reclamation (Appendix 1).

b. Ed Depuit, Assistant Professor of Range Management, University of Wyoming (Appendix 2).

c. Harry Harju, Staff Biologist, Wyoming Game and Fish Department (Appendix 3).

d. Larry Irwin, Assistant Professor of Zoology, University of Wyoming (Appendix 4); L. Irwin, Impact of Coal Mining Activities on Pronghorn Antelope in the Red Rim-China Butte Area, Wyoming, 1981 Annual Report, Department of Zoology and Physiology, University of Wyoming, Laramie, Wyoming 82071 (Jan. 1981).

e. Dave Moody, District Biologist, Wyoming Game and Fish Department (Appendix 5).

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[39] It is noteworthy that the Wyoming Environmental Quality Act (Wyo. Stat. § 35-11-401(a)(vii)(Supp. 1981)) requires the mining operator to file a bond of only $200 per acre (an additional $100 per acre requirement may be imposed) to insure reclamation. These figures, when compared with the cost estimates for actual reclamation given in this section (iii), underscore the risk of failure, and thus the precariousness of a decision to permit mining on Red Rim.

f. Dale Strickland, Supervisor of Biological Services, Wyoming Game and Fish Department (Appendix 6).

g. Elroy Taylor, Project Environmental Specialist, Rocky Mountain Energy Company, Broomfield, Colorado.

h. Memorandum dated June 18, 1981, from District Wildlife Biologist, BLM, to Area Manager, Overland (Appendix 7).

7. Identification of Property Interests.

Our interest is specifically in private, non-federal lands. Private landowners in the area in question include Phil Espee, Taylor Lawrence, and Blake Livestock. We are unaware of any others.

Respectfully submitted,

Howard Geduldig
Howard Geduldig, Legal Intern

Sharon Nelson
Sharon Nelson, Legal Intern

Robert Golten /hh
Robert Golten, Counsel

NATIONAL WILDLIFE FEDERATION
Natural Resource Clinic
Fleming Law Building, Box 401
Boulder, CO 80309
(303) 492-6552

Certificate of Service

I hereby certify that copies of the foregoing Petition for Designation as Unsuitable for Surface Coal Mining Operations have been placed in the U.S. mail, postage prepaid, this 8th day of May, 1982, addressed as follows:

William Thomas, Director
Office of Surface Mining
Wyoming State Office
Mills, WY 82644

Elroy Taylor
Rocky Mountain Energy, Inc.
10 Longs Peak Drive
Broomfield, CO 80020

AFFIDAVIT OF DON CALHOUN

Present Position:	Co-owner with wife of D & C Reclamation Company
Qualifications:	Bachelor of Science in Forestry from the University of Montana. Forester with the USFS for one year. Twenty-five years with the BLM, as forester; as range manager in WA; watershed specialist for six years, responsible for the planning of the Vaile Watershed Program; weed control and watershed specialist in D.C.; district manager in WY; staff leader for recreational programs covering CA, OR, NV, ID, WA, and AK at the BLM Service Center in Portland, OR; Mined Land Reclamation Specialist for the entire BLM for seven years at the Denver Service Center.

The reestablishment of drainage patterns is most difficult anywhere, and could be quite complicated on Red Rim. In the large coal mines around Colstrip, MT drainage pattern reestablishment has been attempted. Some of this reestablishment of drainage patterns has been successful and some has not. Continuous repair and maintenance has often been required to mitigate erosion occuring after thunderstorms. Prior to reestablishment of the drainage patterns, you need a good map of what you want. Next, you need to reshape the overburden with ~~the~~ D.C.C. dozers. This must be done in the summer, after the "mud season" and still early enough to allow time for revegetation before the winter. Finally, the topsoil must be replaced to provide a growth medium for vegetation. To preclude the effects of erosion (e.g., too great an expansion of the gullies and loss of topsoil), revegetation operations must be started before winter. What will be most critical in the gullies is loss of topsoil to erosion, because without topsoil there would be no growth medium for the vegetation.

Cost of reshaping and topsoiling disturbed areas varies greatly. However, to recreate a ~~flat~~ smooth (D.C.C.) area with a 3:1 slope after mining operations generally costs from approximately 5,000 to 5,500 dollars per acre. To recreate a more complex topography, with a goal of reestablishing prior drainage patterns, reshaping and topsoiling could be expected to cost from 6,000 to 7,500 dollars per acre. These figures are based on costs as of three years ago, i.e., there is no indexing for inflation.

On the flat areas, i.e., not in the drainages, conventional tractor can be used to drill seed the reclaimed area. Perennial grasses and some shrubs can be established by this method. Although some problems may be encountered with sagebrush because its seed is so small in comparison to perennial grass seeds, with constant mixing in the hopper, sagebrush seed can be drilled with the grass seeds. To reestablish sagebrush as a dominant species by this method, it would probably take 20 years. At the end of ten years the sagebrush plants might be 12-16 inches high. It would take 20 years for them to reach two feet. Of course, these estimates will be dependent upon rainfall patterns. Labor and machinery would cost $50 per acre and seed, at 15 pounds per acre, would cost more than $90 per acre. Once again, these costs are as of three years ago.

In the gullies, however, conventional use of tractor to drill seeds would be impossible. Further, direct seeding would not be a recommended method to reestablish vegetation. A method providing more immediate establishment of vegetation is required to stabilize the topsoil from the effects of ~~the~~ erosion. One effective method is dry land sodding. An eight foot by five foot by one foot "pad" is laid down on the topsoil in the gully. This pad already contains the desired vegetation species mix, including sagebrush, grasses, etc. This is a slow and expensive method. Much hand labor is needed to fill in the crack once the pad is laid on the uneven surface of the topsoil. These pads should be placed adjacent to each other in a continuous pattern down the drainages. Cost of this process would range from $25 to $50 per pad, i.e., approximately a dollar per square foot. Once again, these prices are as of three years ago. Tap roots extending more than one foot below the soil surface would be damaged in the cutting of the sod pad from its place of origin. Sagebrush plants that are two feet high frequently have a tap root extending ten feet below the soil surface. Therefore, revegetation of gullies using the dry land sodding technique cannot successfully use sagebrush two feet high. Smaller sagebrush, perhaps six inches high, might be the maximum. Therefore, it would take at least 15 years before the sagebrush on these pads achieve a height of at least two feet. Currently, the average height of sagebrush on Red Rim is approximately two feet.

Another alternative might be to use a tree spade and transplant individual sagebrush. As of three years ago, this method would cost from $25 to $30 per plant.

Finally, it must be appreciated that these reclamation sites are often very delicate, requiring fencing to keep livestock out.

The chances for successful revegetation, and therefore reclamation, assuming the aforesaid steps are taken and the requisite money spent, are still less than 50% in my judgment.

Don Calhoun
Don Calhoun

This statement has been made, and sworn to, by Don Calhoun on this 5th day of ~~March~~ April 1982.

My commission expires on My Commission expires August 13, 1984

Bonnie Burns
Notary Public

AFFIDAVIT OF EDWARD DEPUIT

Position: Assistant Professor, Range Management Division, College of Agriculture, University of Wyoming, Laramie, Wyoming

Qualifications: Bachelor of Science Degree in Forestry from Michigan Technological University, Master of Science Degree in Range Science from Utah State University, Ph.D. in Range Science from Utah State University. Research Associate within the Reclamation Research Unit at Montana State University from 1974 to 1980. From 1980 to present, Assistant Professor of Range Management, Specializing in Disturbed Land Reclamation.

Reclamation of habitat disturbed by surface coal mining operations to its pre-mining micro topography, including the myriad of small narrow gullies, has not been emphasized in most prior post-mining reclamation plans. Restoration of contours to a rough facsimile of pre-mining topography is possible, and in a gross sense, such restoration has been achieved in prior reclamation efforts. Micro-contouring, i.e., the creation of narrow gullies, is not out of the realm of possibility. If made a necessary requirement, mining companies could probably undertake such a task. However, costs of reclamation would be increased if such were required. Problems in re-topsoiling the gullies might be encountered. Soil stabilization on sloping sides of the gullies might prove very difficult prior to the establishment of vegetation.

Reclamation of habitat disturbed by surface coal mining operations to its exact pre-mining quality and quantity of sagebrush, including size and distribution of individual plants, may prove technologically and economically difficult within the span of a few years of the commencement of reclamation activities. We have not yet developed adequate technology for immediately successful direct seeding of sagebrush in Wyoming. Transplantation of sagebrush seedlings or mature plants while very much more expensive, is currently a much more reliable method for rapidly reestablishing sagebrush. Even so, it would be prohibitively expensive to employ transplantation methods where the goal is to recreate pre-mining size and distribution of individual plants in the short term by replanting shrubs at pre-mining densities. Rather, it might be more economically feasible to plant shrubs at low densities to comprise a nucleus for future spread of shrubs via seed production. Of course, such a method entails a greater time span before pre-mining density and individual plant-size could be recreated.

On the sides of the gullies, soil moisture conditions may be expected to be more critical than on the flats and gully bottoms. Therefore, revegetation to sagebrush, and shrubs in general, may proceed at an even slower pace on the sides of the gullies. High wind velocities can increase the problems of soil moisture losses from evapotranspiration, increasing the challenge and cost of shrub regeneration on Red Rim.

Soil stabilization problems might be reduced where grasses are planted early in the reclamation process. However, because soil moisture is a limiting factor for sagebrush, competition from grasses can become a major problem in sagebrush reestablishment. Grasses can outcompete sagebrush seedlings for moisture, resulting in loss of sagebrush plants that have not yet become established.

Resolution of the problem of concurrent sagebrush/grass establishment may be possible using such approaches as temporally separating sagebrush and grass establishment dates (i.e., seeding sagebrush first and grasses later), establishing grasses and sagebrush in mosaic zones rather than together, and/or interseeding or transplanting sagebrush into zones which have had previously established grasses removed.

Reclamation of Red Rim to a shrub-grass community which includes four-wing saltbush, instead of sagebrush, is technologically and economically more feasible. Fourwing saltbush seedlings are usually more vigorous and therefore, better competitors with grasses than sagebrush seedlings. I personally do not know if fourwing saltbush would provide a completely acceptable substitute to the pre-mining sagebrush community for pronghorn antelope. However, it might temporarily fill a shrub niche in the plant community until other indigenous shrubs (e.g., sagebrush) have an opportunity to become more firmly established with time.

Edward De Puit
Edward DePuit

This statement has been made, and sworn to, by Edward DePuit on this 23 day of March, 1982.

My commission expires on
Sept. 1, 1984

Wilma L. Johnston - Notary Public
County of Albany
State of Wyoming
My Commission Expires Sept. 1, 1984

Wilma L Johnston
Notary Public

AFFIDAVIT of Harry Harju

Present Position: Staff Biologist for Environmental Affairs Wyoming Game and Fish Department, Cheyenne, Wyoming

Qualifications: Bachelor of Science in Biology, Northern Michigan University, Master of Arts in Biology, Northern Michigan University, Ph.D. in Zoology, University of Wyoming.

As Staff Biologist for Environmental Affairs for five years, supervised data collection under contract to federal agencies for Eastern Powder River Basin, Southcentral and Southwestern Wyoming Coal EISs, provided wildlife input for Wyoming Department of Environmental Quality in their review of mining permits, provided wildlife input for Wyoming's Industrial Siting Administration. Coordinates all Wyoming Game and Fish comments on terrestrial impacts, other environmental projects (pipelines, power lines, etc.) and is involved in unsuitability designations.

Red Rim is valuable habitat for pronghorn antelope because it is both critical and traditional winter range for pronghorn antelope. Because of topographic conditions, when surrounding areas are snowed in, Red Rim's vegetation remains snow-free and available to feeding antelope. For this reason, pronghorn traditionally concentrate on Red Rim where their chances of survival through winter is maximized. Even during mild winters, greater than 1,000 pronghorn antelope winter on Red Rim. These conditions contrast with other regions in Wyoming where there is no Wyoming Game and Fish-designated critical winter habitat for pronghorn antelope because the winters are not as severe and, therefore, the pronghorn do not concentrate on a limited resource.

Because it is traditional winter habitat for antelope, if parts become unavailable due to coal mining operations, it is likely that the same number of pronghorn will use the decreased available habitat, resulting in crowding. Consequences of such crowding include large-scale nutritive deficiency, resulting in decreased survival of the wintering pronghorns and reduced reproductive rate. Because during severe winters this is the only habitat available to these pronghorn, herd losses are predicted to be in proportion to habitat losses.

Coal development should be prohibited on Red Rim because it is critical habitat for pronghorn antelope. There is no evidence that critical habitat, once lost on Red Rim, can be recreated through reclamation. During the last five years, the Wyoming Game and Fish Department has raised few objections to the accommodation of 82 coal, uranium, bentonite, and trona mining operations, because these operations were either not on designated critical winter habitats, or were not on habitats where evidence of reclaimability was totally lacking. There are no data from areas of similar rainfall, vegetation, and soil type that show that an area like Red Rim can be restored.

The Wyoming Game and Fish Department, as guardian of a public resource, is obligated to look after the public interest. It is not acceptable to trade off the public resource (wildlife) for the private resource (coal) when there is little evidence that there will not be irreparable damage to the public resource and when there are numerous other areas containing coal in Wyoming (e.g., nearby Creston and China Butte) where surface coal mining operations would not compromise the public resource. The BLM, in applying Criteria 15 (used to designate an area as "unsuitable for surface coal mining operations") to Red Rim, at first recommended this area be unsuitable for coal development. Subsequently, BLM retreated from this stance. BLM determined that federal lands on Red Rim are available for further consideration for coal leasing.

The above statements are a summary of the Wyoming Game and Fish Department's position on the leasing of Red Rim for coal development and accurately summarize the telephone conversation with Howard Geduldig on February 18, 1982.

Harry Harju

Harry Harju

This statement has been made, and sworn to, by Harry Harju on this 28th day of February, 1982.

My commission expires on

Aug. 25, 1982

Arthur D. [illegible], Jr. - Notary Public
COUNTY OF LARAMIE
STATE OF WYOMING
My Commission Expires Aug. 25, 1982

Arthur D. [illegible]

Notary Public

AFFIDAVIT of Larry L. Irwin, Ph.D.

Present Position: Assistant Professor of Zoology, Department of Zoology and Physiology, University of Wyoming, Laramie, Wyoming.

Qualifications: Bachelor of Science in Wildlife Biology from the University of Montana. Masters of Science in Wildlife Biology from the University of Idaho, and Ph.D. in Wildlife Biology from the University of Idaho. Conducted various studies of wildlife habitat use patterns and selection since 1972.

Without qualification the Red Rim area is extremely valuable habitat for pronghorn antelope. On the basis of three winters observations by myself supplemented by the observations of the Wyoming Game & Fish Department, the Red Rim is used by 1200 to 1500 antelope each winter, even under the mildest of conditions. During the severe winter of 1978-79 between 2400 and 2800 pronghorn used the Red Rim, according to Wyoming Game and Fish Department personnel. Severe winter conditions are characterized by prolonged periods of sub-zero degree Fahrenheit or lower temperatures accompanied by continuous deep snow conditions and frequent high winds.

The Red Rim complex is unique. It is a 26,000 acre uplifted area, the rim running from northeast to southwest. Prevailing winter winds come from the west and southwest blowing across the broad northwest face and tending to keep this uplifted face relatively snow free.

On the southern 1/2 of Red Rim, the uplifted area is folded into rolling hills with draws running from east to west and northwest. These draws are very important in providing the pronghorn antelope with wind protection. Until the winter snows fill in the draws, antelope are generally found in these draws. We suspect that the vegetation (including big sagebrush, winter fat, and rabbit brush) is of a higher nutritive value to the pronghorn antelope because it is protected from the desiccating effect of the wind. Therefore, both the relative size of the the uplifted area and the topographic relief on the uplifted area contribute to make the Red Rim unique when compared with adjacent areas.

If the Red Rim habitats were rendered unavailable to wintering pronghorn antelope some of them would probably move south along Muddy Creek and compete for winter forage elsewhere. However, some would remain in the Red Rim area and would suffer the consequence of increased population densities as a result of habitat loss. The extent of population loss depends, in large measure, on whether the wintering population extends Red Rim to the limit of its carrying capacity.

Permitting surface coal mining operations will predictably reduce Red Rim's current capacity to support pronghorn antelope during critical winters. While the northeastern portion of the Rim is less important to antelope because it is drier, the antelope do move there to avoid poorer conditions at the higher elevations on the other, more important, parts of Red Rim. As the proposed mining operations move south, the more important (and higher-elevation) middle and southwestern portion of the Rim will provide reduced capability for support for wintering pronghorn antelope. In short, coal development would result in loss of critical habitat for wintering pronghorn, and potential consequent loss of substantial numbers of animals.

If economic and political considerations dictate that coal development be permitted on Red Rim and increased levels of hunting are not used to reduce wintering pronghorn population, useful scientific data might be accumulated that would help in the future to predict wildlife losses arising from loss of habitat through such surface disturbances as coal mining. However, as a wildlife conservationist, it would be unethical to allow Red Rim to become a scientific example, because losses to the population will undoubtedly occur, even though we are not certain at what level. In addition the development of Red Rim is just 1 of a long list of cumulative impacts in the area, which realistically should not be considered alone. Further, the danger of establishing the precedent that allows industrial disturbances on lands designated by the Wyoming Game and Fish Department as critical wildlife habitat must not be discounted.

Larry L. Irwin

This statement has been made, and sworn to, by Larry L. Irwin this 22 day of March 1982.

My Commission expires on

Oct. 11, 1982

Mary L. Noel
Notary Public

MARY L. NOEL - Notary Public
County of Albany
State of Wyoming
My Commission Expires Oct. 11, 1982

AFFIDAVIT of Dave Moody

Present Position: District Biologist for Wyoming Game and Fish Department, Baggs, Wyoming.

Qualifications: Bachelor of Science in Wildlife Management, University of Wyoming. One and one-half years as Biological Aide for Wyoming Game and Fish Department. District Biologist since 1977 and is responsible for planning, scheduling, and carrying out data collection for various species of wildlife. Collected data on pronghorn antelope in the Baggs area for 5 years.

Red Rim is valuable habitat for pronghorn because it is critical winter range in the Baggs area. In the Bagg's area, the availability of critical winter range is the limiting factor on pronghorn population-without it much of the herd would perish. During severe winters, approximately 2,800 pronghorn winter on Red Rim. During non-severe winters, upwards of 1,300 pronghorn winter on Red Rim.

The Baggs pronghorn antelope herd selects and utilizes specific habitat from year to year, even during mild winters like the current one. The closest alternate critical winter habitat for these pronghorn is 25 miles away. During most winters, the conditions would preclude pronghorn movement from Red Rim to the alternate critical winter habitat to the south. If parts of Red Rim's critical winter habitat become unavailable to wintering pronghorn, rather than search for new habitats, these pronghorn would crowd together and suffer reduced survival and reproduction rates.

Red Rim can sustain pronghorn antelope through winter, in part, because of its physiographical features. Its southwest facing uplift is blown clear of snow by southerly and westerly winds. It has numerous draws running to the south and west providing habitat in which big sagebrush attain heights of 2 feet to 5 feet. These micro-habitats offer essential shelter to wintering pronghorn.

Red Rim's capacity to sustain pronghorn antelope through winter is due, in part, to the various vegetative communities that these pronghorn select. The diversity of shrubs and shrub densities on pronghorn feeding and cover sights is most important. These shrubs range in height from a low of approximately 15 inches, on open feeding sights, to a high of approximately over 5 feet in the draw. Characteristic shrub densities are from 15% to 40% cover on open feeding sights to 30% to 60% cover in the draws. These shrub densities are approximately 4 times those achieved on the RME test plots maintained under idealized circumstances. RME's study was conducted two years with extremely wet springs, i.e., at least 90% greater than average for Red Rim. RME's study was done low on the Rim, where top soil depth is much greater than average for Red Rim. A key question is the amount of time to reclaim. While I am aware of no documentation that Red Rim is reclaimable, if Red Rim were reclaimable, it would take from 40-60 years based on current techniques.

The delineation of critical winter habitat for Baggs DAU was reached in joint discussions by the BLM and Wyoming Game and Fish Department, finalized during the spring of 1977. This was before the current controversy on

Red Rim had developed. The last projected surface occupancy by mining interests on Red that I was shown, excluding ancillary mining activities, coincided with 60% of the pronghorn critical winter habitat on Red Rim. During critical winters, occurring every 5-7 years, we assume a direct relationship by the loss of habitat and loss of animals. Up to 1,600 pronghorn would be lost with 60% disturbance of the Red Rim critical winter habitat.

For the above reasons, I feel that no coal development, or any other massive disruption, should be permitted on Red Rim.

Dave Moody

This statement has been made, and sworn to, by Dave Moody on this 23 day of March, 1982.

My commission expires on

Notary Public

Lawrence J. Gabriele - Notary Public
COUNTY OF LARAMIE
STATE OF WYOMING
My Commission Expires Dec. 25, 1984

AFFIDAVIT of Dale Strickland, Ph.D.

Present Position:	Supervisor of Biological Services Wyoming Game & Fish Department, Cheyenne WY
Qualifications:	Bachelor of Science Degree in Zoology from the University of Tennessee. Masters of Science Degree in Wildlife Management from the University of Tennessee. Doctor of Philosophy in Ecology and Wildlife Management from the University of Wyoming. Numerous wildlife studies in big game including population dynamics, habitat utilization, habitat evaluation and food habits.

The Red Rim is valuable habitat for pronghorn antelope. It is critical winter range for a portion of the Baggs pronghorn antelope herd as defined by the Wyoming Game and Fish Department, i.e., that habitat that is in the shortest supply and is the limiting resource for the entire herd unit. Sex ratio, age-structure, and harvest data have been computer-analyzed to produce a wintering population estimate on Red Rim of from 1,000 to 2,400 pronghorn antelope during the winters of 1977-78 through 1980-81. It was during the severe winter of 1978-79, when snow cover was both extensive and long-lasting in the areas around Red Rim, that the maximum population estimate, 2,400 pronghorn antelope, was made. These data evidence the propensity of pronghorn antelope to go on to, and presumably use, Red Rim when resources are most limiting.

The shrub-grass vegetation mixture is extremely important in meeting the essential dietary needs of this pronghorn herd. Up to 95% of the winter diet of pronghorn is shrubs, primarily big sagebrush. Because the predominately southwesterly winds blow across the sagebrush-covered northwest face of Red Rim, this herd of pronghorn antelope is provided with the opportunity to feed upon big sagebrush when such opportunity is precluded in adjacent areas due to greater snow cover. Further, the face of Red Rim is cut by numerous draws, giving protection from the wind to the pronghorn antelope during resting and high wind periods. Therefore, it is the conjunction of topography and vegetation type that contributes to Red Rim's being extremely valuable habitat for pronghorn antelope.

Where conditions for pronghorn antelope are such that the habitat is critical, it is predicted that the proportion of the total area of critical habitat that is rendered unavailable for pronghorn use would result in a corresponding reduction in the herd's population. For example, during a critical winter where 2,400 pronghorn might be expected to use Red Rim, if surface coal mining operations rendered 60% of Red Rim unavailable to pronghorn antelope, it is predicted that less than 1,000 pronghorn could be maintained on Red Rim.

For the above reasons the Red Rim is, in my judgment, critical wildlife habitat, and - because of both short and long-run impairment that would arise from coal development, if permitted - should be put off-limits to (i.e., declared "unsuitable") for coal development.

The above statements are a summary of the Wyoming Game and Fish Department's position on the leasing of Red Rim for coal development and accurately summarize the telephone conversation with Howard Geduldig on February 18, 1982.

Dale Strickland
Dale Strickland

This statement has been made, and sworn to, by Dale Strickland on this 26 day of February, 1982.

Arthur D. Reese, Jr. - Notary Public
COUNTY OF LARAMIE
STATE OF WYOMING
My Commission Expires Aug. 25, 1982

My commission expires on
Aug 25, 1982

Arthur D. Reese Jr
Notary Public

Memorandum

BUREAU OF LAND MANAGEMENT

IN REPLY REFER TO

6514

TO : Area Manager, Overland

FROM : District Wildlife Biologist

SUBJECT : Red Rim Suitability Analysis

Date: [illegible]

Enclosed is the Draft Suitability Analysis prepared by district wildlife staff. We have incorporated comments made in the June 16 meeting and believe that this is a thorough analysis of unsuitability criterion 15 as it relates to the Red Rim tract.

1 Enclosure:
Encl. 1 - Draft Suitability Analysis

ENelson:bak:6/18/81

PRELIMINARY DRAFT SUITABILITY ANALYSIS

I. INTRODUCTION

This report is an analysis of data relevant to the final decision concerning the application of unsuitability Criterion 15 to the Red Rim coal tract. It includes an analysis of (1) the significance of important wildlife habitats on the Red Rim tract; (2) the feasibility of reclaiming the habitat to its premining potential should mining occur; and (3) subsequent impacts on wildlife populations.

II. BACKGROUND INFORMATION

In July 1979, under the Secretary of the Interior's new coal leasing policy, the Overland MFP was updated to summarize decisions made regarding the leasing of Federal coal in the Red Rim/China Butte area.

Through application of the coal unsuitability criteria, areas with key features or environmental sensitivities were designated "unsuitable" for coal mining and therefore not suitable for coal leasing. Other areas were designated "unacceptable" based on multiple use considerations or "acceptable" for further consideration for coal leasing and development.

The "acceptable" designation was further divided into three separate categories: (1) acceptable; (2) acceptable pending further study; and (3) acceptable pending further inventory.

During this process pronghorn antelope, mule deer, and sage grouse were identified by the Wyoming Game and Fish Department (WGFD) as species of high interest to the state under Criterion 15. This criterion specifies that:

> Federal lands which the surface management agency and the state jointly agree are fish and wildlife habitat for resident species of high interest to the state and which are essential for maintaining these priority wildlife species shall be considered unsuitable. Examples of such lands which serve a critical function for the species involved include: (1) active dancing and strutting grounds for sage grouse, sharp-tailed grouse, and prairie chicken; (2) winter ranges most critical for deer, antelope, and elk; and (3) migration corridors for elk.
>
> A lease may be issued if, after consultation with the state, the surface management agency determines that all or certain stipulated methods of coal mining will not have a significant long term impact on the species being protected. (Federal Register, July 19, 1979).

On the Red Rim coal tract, Bureau of Land Management (BLM) and WGFD wildlife biologists delineated certain lands as important winter range for antelope and other lands as important strutting/nesting grounds for sage grouse (See Figure 1). The department considers the winter range crucial to the survival of antelope in the area, especially during the periodic occurrence of a critically severe winter. The application of Criterion 15 to the Red Rim tract resulted in a decision to designate these lands "acceptable pending further study", in order to (1) collect additional data upon which to more specifically estimate the impacts on Criterion 15 species as a result of mining the Red Rim tract; and (2) allow time for private industry to develop or demonstrate proposals for reclamation.

Since that time, the University of Wyoming has been conducting a study of the antelope population in the Red Rim area in cooperation with government agencies and private industry, while Rocky Mountain Energy Company (RME) and the BLM have been conducting a study on the Red Rim tract to determine the feasibility of reclaiming the winter range. In addition, vegetation, landsat imagery, weather, and browse utilization data have been compiled by BLM staff biologists with the cooperation of personnel from RME and the WGFD. The following sections are an analysis of this data and its relationship to the final decision involving unsuitability Criterion 15 on the Red Rim tract.

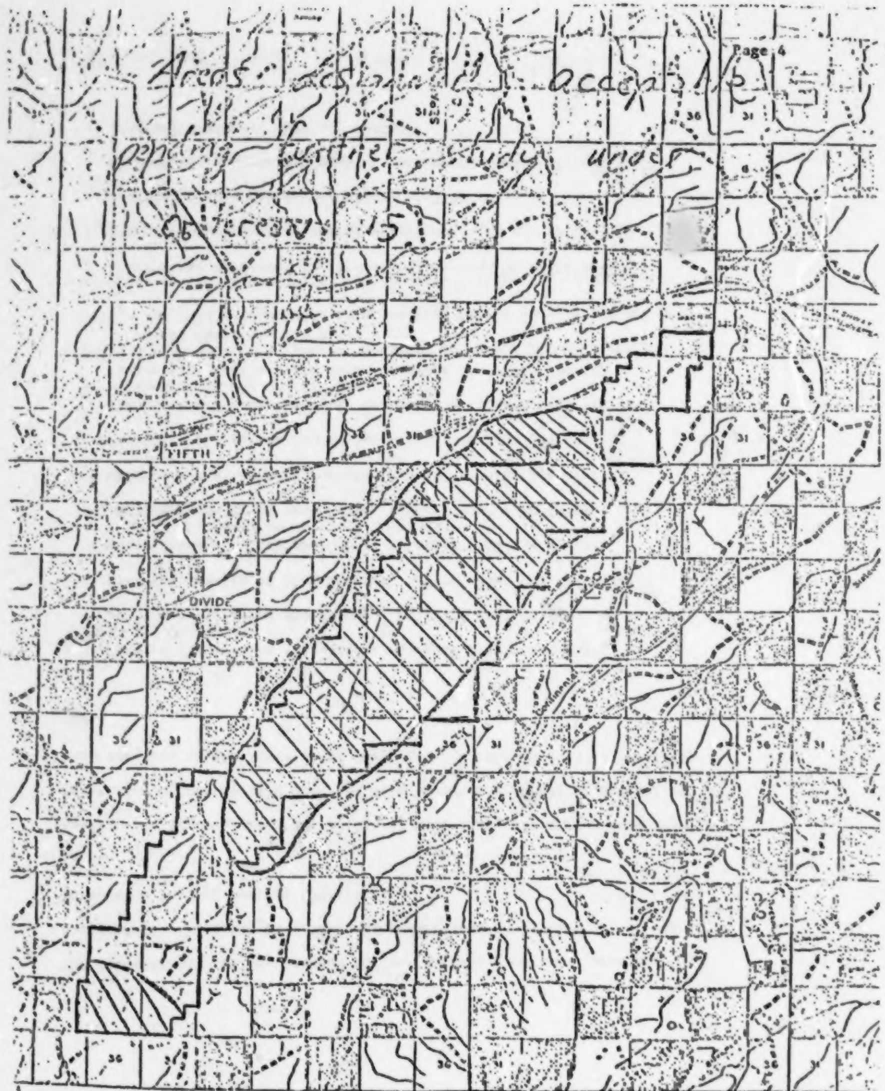

Page 4
Areas designated acceptable pending further study under criterion 15
FIFTH
DIVIDE
36
31
6
1974

FIGURE 1

III. SIGNIFICANCE OF THE RED RIM COAL TRACT FOR CRITERION 15 WILDLIFE SPECIES

A. CHARACTERISTICS OF CRITICALLY SEVERE WINTERS IN THE RED RIM AREA

An analysis of climatological data was undertaken to determine what constitutes a critically severe winter. Daily records of temperature and snow for the months of November through April, 1970-1981, were obtained from the Rawlins, Wyoming FFA weather station. Records for the winters of 1972-1973 and 1978-1979 considered critically severe for wildlife by WGFD, are summarized in Table 1, along with the winter of 1979-1980 for the purpose of comparison. The universities' pronghorn study refers to the 1979-1980 winter as "considered by many to be quite severe" (Irwin, et. al. 1981, p.61). However, the primary factor affecting wildlife during winter is the duration of snow cover, determined by temperature, wind velocity, and snowfall. Snow cover effectively determines wildlife mobility and forage availability. The data on Table 1 indicates that during the winters of 1972-1973 and 1978-1979 the duration of snow cover was significantly greater than during the winter of 1979-1980. In addition, mean temperatures, which affect the rate of snow melt and sublimation, were also significantly lower during the two critically severe winters. Therefore, the primary characteristic of a critically severe winter is the duration of ground snow cover, and its effect on forage availability and animal mobility.

Table 1

MONTHLY MEAN TEMPERATURE AND SNOW ON GROUND

Month	Mean Temperature (degree Fahrenheit)		Number of Days with More Than 3 Inches Snow on Ground
	1972-1973[1]		
November	26.10		8
December	17.20		24
January	13.90		31
February	17.00		28
Average Mean Temperature	18.55	Total Days	91
	1978-1979[1]		
November	29.00		4
December	13.90		30
January	9.10		31
February	24.70		13
Average Mean Temperature	19.18	Total Days	78
	1979-1980		
November	22.60		13
December	27.60		6
January	19.20		13
February	24.80		22
Average Mean Temperature	23.55	Total Days	54

[1] Considered a critically severe winter for wildlife by Wyoming Game and Fish Department.

B. CHARACTERISTICS OF THE RED RIM COAL TRACT IMPORTANT FOR CRITERION 15 WILDLIFE SPECIES

Vegetation

Except for its availability to wildlife during a critically severe winter, vegetation on the Red Rim coal tract is not significantly different from vegetation adjacent to the tract or from that of other coal tracts already leased and mined in the Hanna Basin KRCRA. A detailed vegetation map, prepared and submitted by RME, indicates the vegetative cover is composed of extensive stands of big sagebrush, with somewhat less extensive stands of greasewood, saltbush, and mountain shrub vegetation. A vegetative characterization of the Red Rim study area has been completed by RME for the 1980 growing season. The study delineated eight vegetation types. Annual productivity for grass and forbs and density per square acre of shrubs per vegetation type were also calculated. Big sagebrush is the single most important vegetation type on the tract for antelope and sage grouse. In a study by Olsen and Hansen (1977) on the Red Desert, sagebrush made up 77 percent of the fall diet of antelope and over 95 percent of the winter diet. Furthermore, it has been conclusively documented that sage grouse are solely dependent on sagebrush from October to April (Braun et. al. 1977). Sagebrush also makes up over 50 percent of the diets of mule deer on winter range. Also, the Red Rim antelope studies (Irwin et. al. 1981) indicate some selection by antelope for the sagebrush-grass type under winter conditions.

2. Topography

The most significant feature of the Red Rim area is its topography, characterized by broken, rolling terrain between the floodplain of Separation Creek to the west and the crest of Red Rim to the east. During a critically severe winter, ridgetops and southwest to northwest facing slopes in this area are windswept and clear of excessively deep snow. Stands of big sagebrush exposed on these windswept sites are heavily utilized by antelope, sage grouse, and mule deer. In addition, during periods of below normal temperatures, the leeward sides of these windswept ridges provide animals with bedgrounds protected from the effects of extreme wind chill.

Areas adjacent to the Red Rim tract do not have these. characteristics. As stated in the Overland MFP update of July 31, 1979, off-site mitigation was considered, but deemed unfeasible for the Red Rim site, based on current information, because of the topographic characteristics of the site. The Red Rim area offers unique topographic features which are unavailable off-site. The areas to the east are too flat to provide relief from the wind and forage above the winter snows. The areas to the west are also not of a favorable topographic nature and are expected to become active mining operations within five years. The narrow band of habitat to the north is of similar terrain but strongly increases the possibility of collisions with trains and cars and is too small to support this population. The winter ranges to the south, which usually support the bulk of the wintering herd, would be unavailable to these additional animals when migration to the south is blocked by extreme weather conditions.

C. SIGNIFICANCE OF THE RED RIM COAL TRACT FOR PRONGHORN ANTELOPE

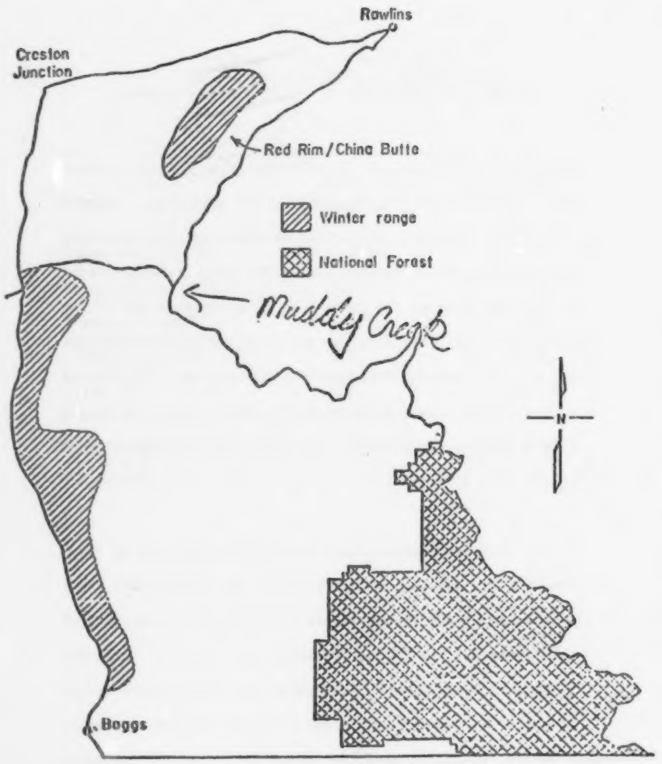
1. Antelope Crucial Winter Ranges in the Baggs Data Analysis Unit (DAU)

The Baggs DAU is an area occupied by an individual population of antelope relatively isolated from adjacent populations by geographic and manmade physical barriers. Within the DAU there are two major antelope crucial winter ranges as delineated in WGFD and BLM field data (Figure 2). The Red Rim crucial winter range, overlapping the Red Rim tract, is approximately 16,000 acres in size. The other major crucial winter range is approximately 63,300 acres in size, and is located along Muddy Creek and Highway 789 in the southwest portion of the DAU. Together they total 79,300 acres.

The Red Rim crucial winter range makes up only 20.2 percent of the total; however, its periodic isolation in that area of the DAU north of Muddy Creek increases its significance to antelope survival. This disproportionate significance is a result of antelope distrubution within the DAU. For example, BLM aerial surveys during January of 1981 showed over 7,000 antelope were distributed in the Red Rim portion of the DAU north of Muddy Creek. This is approximately 77 percent of the total post-harvest population estimated for the DAU at that time.

2. Proportion of the Total Baggs DAU Antelope Population Dependent on the Red Rim Crucial Winter Range

The WGFD bases management of the Baggs DAU antelope population on a computer model known as "One Pop" which simulates the dynamics of the DAU population. Through what is known as data alignment, the original population and mortality estimates



CRUCIAL ANTELOPE WINTER RANGE WITHIN THE BAGGS DAU

FIGURE 2

(1971) are adjusted until the model is producing accurate predictions of annual field data. In other words, the model is adjusted until it is making accurate predictions of data on annual harvests, fawn-doe ratios, and buck-doe ratios, which are collected each year in the DAU. In addition, the model estimates the total population size and mortality at four points in time during the year. A model which is making accurate predictions of reliable field data, such as data on annual harvests, is said to be "tracking well", and its subsequent predictions of population size are considered dependable. At least five states are currently using "One Pop" to estimate wildlife populations (Pojar and Strickland, 1979).

Rawlins District staff biologists have reviewed the "One Pop" simulation model with WGFD personnel and agree that it is a useful tool for estimating the size of the Baggs DAU antelope population. Furthermore, by comparing the computer population estimate with an aerial count of the entire DAU, an adjustment factor can be calculated to account for animals missed in an aerial census. Past experience has shown that a significant proportion of the antelope population is missed during an aerial census. Even under ideal conditions of weather, light, and ground cover, a total count of all individuals can never be made. The number of animals missed increases drastically as ideal conditions deteriorate. Therefore, census data must be adjusted upward in order to reflect missed animals.

The factor used to adjust aerial census data for this analysis was determined by comparing actual counts of the entire DAU with the population estimate from the WGFD computer model. Actual counts of the entire DAU by WGFD during March of 1979 and 1980 turned up 4,058 and 4,281 antelope, respectively. The computer model estimated the total population size at 7,104 and 7,290 animals at the same point in time. The difference between the computer estimate and the actual count each year indicates that approximately 40 percent of the DAU population was missed during the aerial census.

Aerial census data of the Red Rim crucial winter range collected during the critically severe winter of 1978-1979 is presented in Table 2. Counts indicated that as patterns of snow accumulation changed, animal distributions changed. Harsher weather conditions concentrated greater numbers of animals on the crucial winter ranges; whereas, moderate conditions allowed animals to spread out onto adjacent areas. Furthermore, methodology varied between counts. In addition to counting

Table 2

AERIAL CENSUS DATA COLLECTED
ON THE RED RIM CRUCIAL WINTER RANGE
DURING THE CRITICALLY SEVERE WINTER OF 1978-1979

Date	Agency	Actual Count
December 7, 1978	BLM & WGFD	1,115
December 14, 1978	BLM	719
January 5, 1979	BLM & WGFD	689
January 19, 1979	BLM	1,028
February 26, 1979	WGFD	1,408[1]

[1] Actual count upon which total antelope numbers dependent on the Red Rim tract was determined.

antelope, an objective of the earlier counts was to delineate the boundaries of the crucial winter range, based on animal distribution. Only the count by the WGFD on February 26 was conducted according to the same methodolgy used to count the entire DAU. Therefore, only this count is used to estimate the percent of the DAU population dependent on Red Rim. After an upward adjustment of 40 percent to account for missed animals, the data results in an estimate of 2,350 antelope, or 33 percent of the 1978 post-winter DAU population estimated by the WGFD.

However, the above figure of 2,350 antelope is based on the 1978 total post-winter population of 7,100 antelope for the DAU. The present WGFD objective is a total post-harvest population of 7,200 antelope by 1985. Therefore, an estimate of total numbers dependent on Red Rim should be based on the 1985 post-harvest objective of 7,200 antelope. The analysis of 1978-1979 data showed 33 percent of the total DAU population dependent on Red Rim. Based on 33 percent of the 1985 population objective, there are 2,400 antelope dependent on the Red Rim crucial winter range.

2. Significance for Sage Grouse

The Washakie Basin Sage Grouse Study (1980) conducted by RME has identified the Red Rim area as a major sage grouse wintering area. High concentrations of grouse were observed during the 1979-1980 winter in the areas delineated in Figure 3. A single flock observed along Separation Creek in the southwest part of the Red Rim tract contained over 1,000 birds. Birds trapped and radio-tagged on their winter ranges remained within 4-miles of the trap site until the strutting season.

Three sage grouse strutting grounds occur within 2-miles of the Red Rim tract boundaries (Figure 4). An unknown amount of nesting does occur on the Red Rim tract and in addition, the area along Separation Creek is used as brood-rearing habitat.

It is not possible with current data to predict the relative importance of these areas in maintaining sage grouse populations in the Red Rim area.

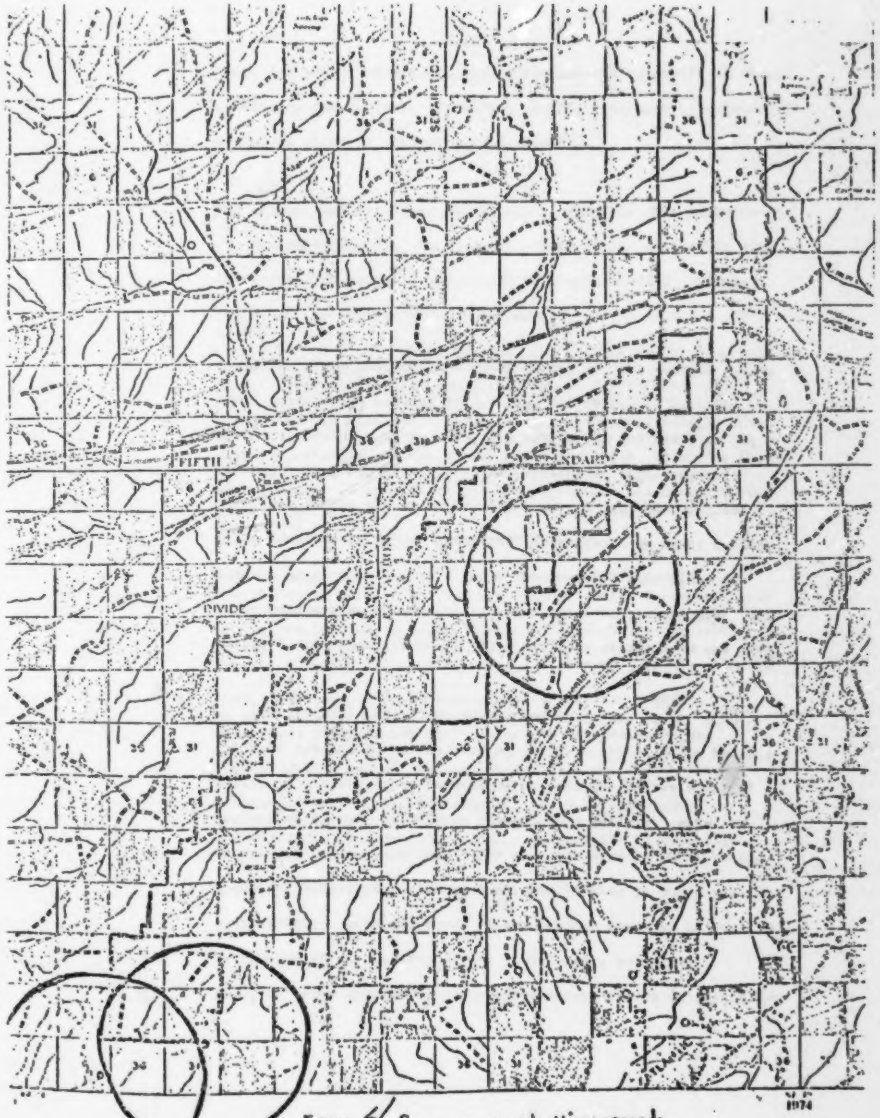


Figure 4 Sage grouse strutting grounds.

3. Significance for Mule Deer

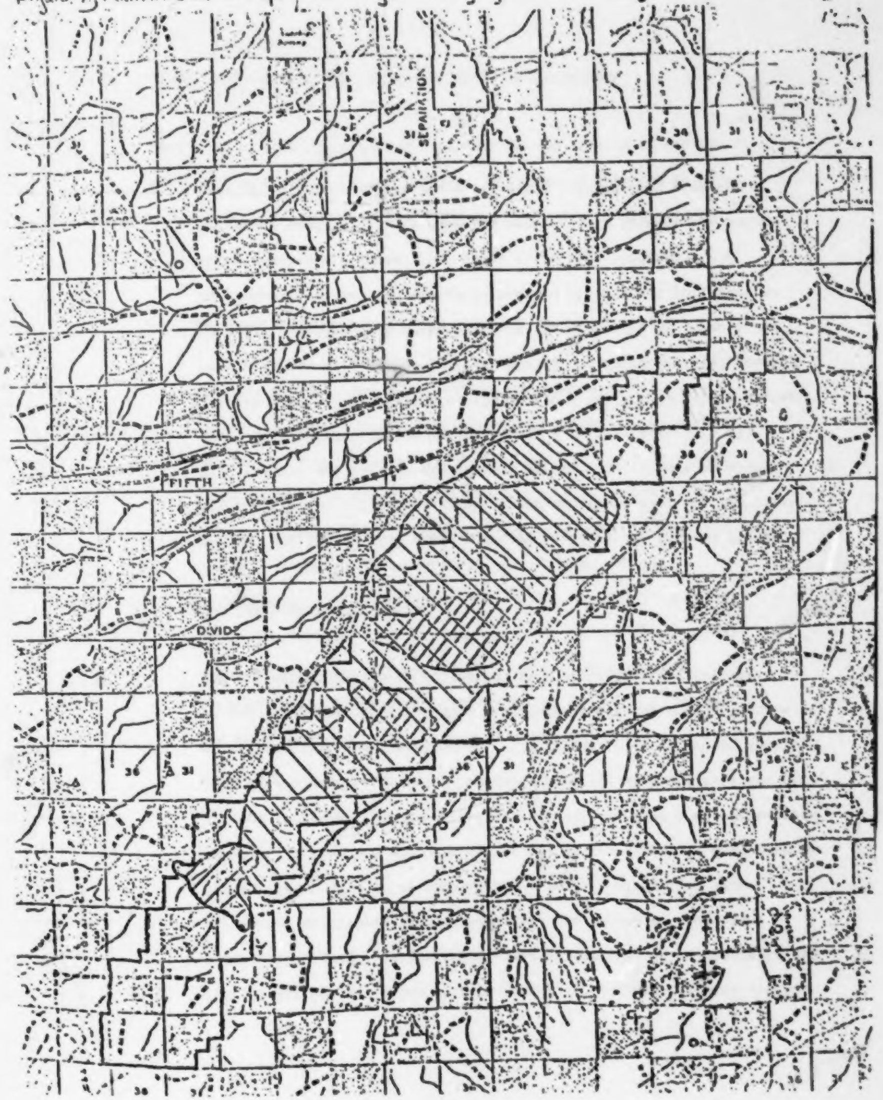
Approximately 50-150 mule deer are present year-round on Red Rim, using areas on and immediately east of the tract along the crest of Red Rim. The crucial winter range used by these animals is located in the northern half of the antelope crucial winter range (Figure 5).

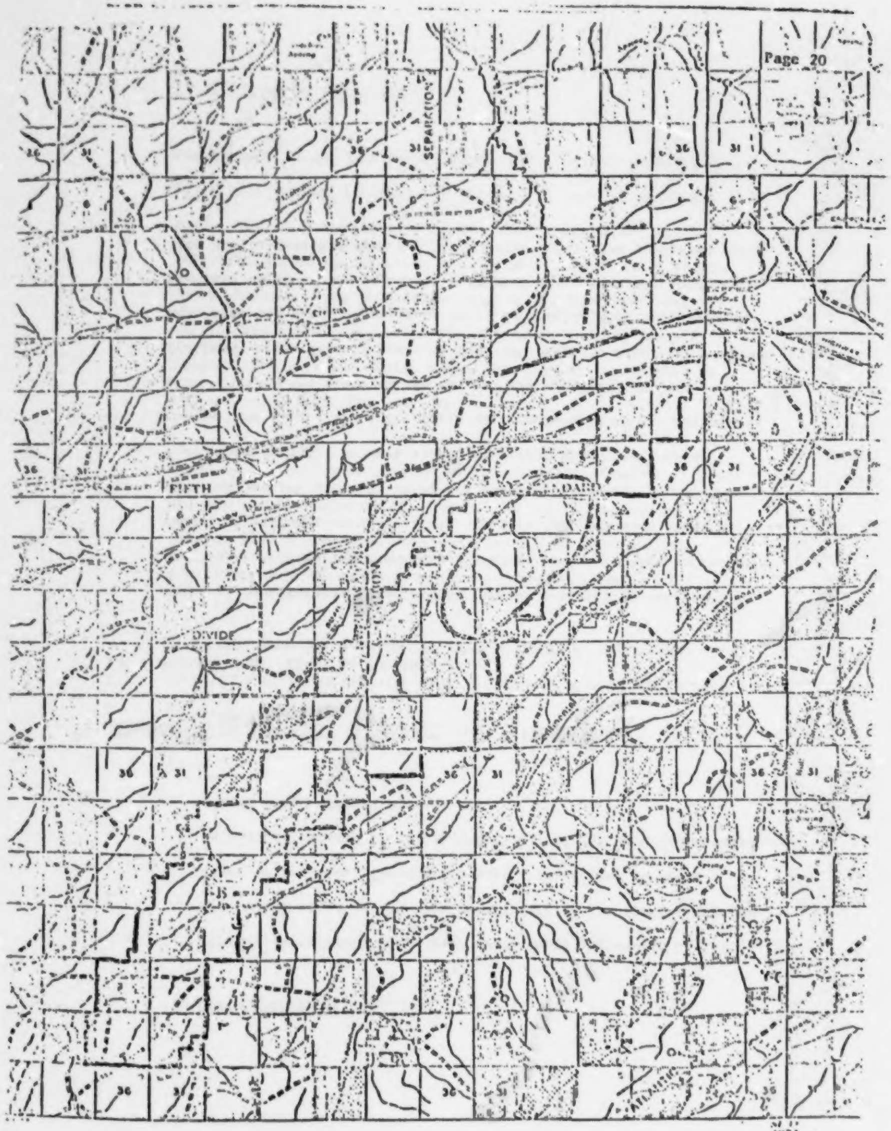
IV. FEASIBILITY OF RECLAIMING THE RED RIM CRUCIAL WINTER RANGE

A. RECLAMATION: STATE OF THE ART

There is considerable disagreement between reclamation specialists discussing reclamation results for a given area. We have contacted a number of reclamation specialists who have seen and been involved with reclamation projects using sagebrush, greasewood, or mountain shrub communities. We have found no studies which indicate a reclamation time. Few specialists want to be held to a reclamation time based on the state of the art. These specialist's "gut feelings" range from 15 years to over 100 years to establish original densities and plant composition on sites ranging from sagebrush to mountain shrub. One specialist indicated for a mountain shrub type, "the entire growth medium has been disturbed". "The change in soils

Figure 5. Boundaries of antelope winter range and sage grouse winter ranges from RME study.





and subsoil may not allow this community to approach original density within 100 years." Another specialist argued that it is difficult and not useful to discuss reclamation time. He wanted to indicate a desired level of species density per acre in a given time frame. For example, in year one of reclamation, 10,000 seedlings per acre must be present to achieve desired reclamation results. Year 4 of reclamation must have a minimum of 4,000 healthy plants per acre and continue this time frame throughout reclamation. It is not clear who would monitor or enforce these numbers. This discussion indicates that the state of the art cannot forecast reclamation time or reclamation methods.

B. RED RIM RECLAMATION STUDY

The Red Rim reclamation study, jointly conducted by RME and BLM on the Red Rim crucial winter range, has established that big sagebrush will survive and exhibit significant growth when (1) mature plants are transplanted with a tree spade onto a nearly level site (2) adequate topsoil is available; (3) moisture conditions (above average precipitation or supplemental irrigation) are favorable; (4) grazing by large herbivores is prevented; and (5) densities of rodents and lagomorphs are not high enough to exert a significant influence on shrub survival. In addition, under these same conditions big sagebrush seeds will germinate and begin growth between the mature transplanted shrubs when there is no competition from grasses.

C. ALTERNATE RECLAMATION METHOD

Climatic factors (precipitation, wind, evaporation), soil, percent slope, slope aspect, and consequently microhabitats are extremely variable between reclamation sites in the west. Success on one site does not indicate success on a different site even though many of the variables appear similar. Crofts (personel communication) indicates good success in transplanting mature mountain shrub species (aspen, chokecherry, serviceberry). Pads of soil, 60 to 65 square feet in size, are transplanted with a modified scoop on a front end loader. Three to five pads comprise an island. Islands occupy from 1 to 2 percent (maximum of 3 percent) of the total revegetated area. The remaining areas are seeded to an annual grain mulch, then seeded to a reclamation seed mixture. Soil must have structure and be moist for pad transporting to be successful. This limits good operations to the spring and fall. Consequently, there is a backlog since mining continues throughout the year. Annual precipitation on the site is 16 to 18 inches (Rawlins annual precipitation approximates 9.5 inches). Bray (personal communication) indicates some sagebrush was transplanted from the pad, but it is not invading back to premining density. Crofts indicates a site must be stabilized before reclamation can even be considered. In reclaiming an area of 16,000 acres, Monsen (personal communication) feels that most of the area must be seeded for feasible reclamation.

D. FACTORS INFLUENCING THE SUCCESS OF SHRUB ESTABLISHMENT

Many factors have considerable influence on the success or failure of establishing shrubs on mined lands. The following analysis relates these factors to the feasibility of reclaiming the crucial winter range.

1. Moisture Available to Plants

Adequate moisture has been available to plants on the study site to date. Average annual precipitation recorded at the Rawlins FAA weather station from 1949-1950, 1952-1980 was 9.33 inches. Annual precipitation ranged from a low of 4.90 inches (1954) and a high of 12.37 inches (1949). Annual precipitation for 1980 was 11.2 inches, 20 percent above our average. Monthly precipitation for January-May 1981 is also running 20 percent above the average. The precipitation for May in 1980 and 1981 was recorded at 94 percent and 126 percent above average, respectively. Consequently, sagebrush on the reclamation site has been receiving above average precipitation since the study's beginning.

Drought conditions may have a significant effect on the survival of the seedlings and transplants in the future. Monsen (1980) indicates plant failure is very high in areas receiving less than 9 inches annual precipitation. Very few species will take hold. Clarke and Depuit (1980) in their southeastern Montana reclamation study indicate that precipitation of approximately 9 inches has an inhibitory effect on initial establishment of sagebrush seed by reducing germination and increasing seedling mortality. In their study, initial establishment densities of all shrub species including sagebrush were adversely affected by this level of precipitation. Nine inches of precipitation, normal for Rawlins, was drought conditions for the study area which normally recieved 15.13 inches of annual precipitation.

Supplemental irrigation may be absolutely necessary in some years on extensive acreages. According to Frischknecht and Ferguson (1979) in a reclamation study conducted on a coal field in Kane County, Utah, evapotranspiration demand is intensified by periods of high winds. In addition, much of the precipitation is ineffective in replenishing soil moisture due to surface runoff or diminutive amounts of less than 0.25 inches (0.6 cm) per event. Moreover, the extreme variability in the occurrence of rainfall and winter snows makes any seeding or planting program risky without supplementary water to aid plant establishment. Water availability has not been studied on the Red Rim tract to determine the feasibility of supplemental irrigation.

As previously discussed, the broken topography and exposure on Red Rim creates the crucial winter range. Soil moisture will be considerably less on the windward side of the upper half and tops of ridges. These windswept areas, most important for antelope, will be receiving significantly less moisture and consequently will be considerably more difficult to reclaim.

2. Competition

Competition between plant species has been a major problem in reclaiming arid areas of the west. To prevent soil erosion due to high winds or water runoff on steep slopes, past reclamation practices have emphasized soil stabilization by seeding grasses. However, grasses inhibit the invasion of sagebrush (Monson and Christensen, 1975). At the Seminoe I mine in Hanna, areas seeded with grasses showed no invasion of sagebrush from adjacent areas.

To inhibit soil erosion and establish sagebrush, plugs or mature big sagebrush would have to be planted and grasses seeded between plugs. However, these grasses would adversely effect the further invasion of sagebrush and inhibit the establishment of big sagebrush to premining densities (Monson and Christensen, 1975).

Competition between sagebrush and "weedy" species such as Russian thistle will also inhibit the establishment of big sagebrush to premining densities.

Broadcast seeding of a mixture of grasses and sagebrush would require a much longer reclamation period and would be successful only under ideal weather and soil conditions with a minimum slope. Competition between sagebrush and grasses would still be a significant problem.

3. Soils

There are nine soil associations in the Red Rim tract ranging in depth from 0 to 60 inches. The reclamation potential of these soils ranges from poor to good (BLM, Red Rim SSA, 1979). Although the removal of topsoil and overburden would cause the soils to be unconsolidated and the soil profiles destroyed, soil productivity would be restored to premining levels in the long term (BLM, Red Rim SSA, 1979).

Adequate well developed topsoil was available on the study site; however, it is unlikely that adequate amounts of topsoil will be available to reclaim the entire disturbed area. Subsoils will have to be treated and used as topsoil. In Parachute, Colorado, where annual precipitation is as high as 20 inches, two species of sagebrush and one species of rabbitbrush showed very low survival when less than one foot of topsoil was replaced on the mined area (Frishknecht and Ferguson, 1979).

4. Herbivores

All reclaimed areas would have to be fenced to prevent grazing by domestic livestock and antelope. Establishment of big sagebrush would be much faster and more successful if all areas are fenced. In one reclamation study done in Colorado and Wyoming, the woody shrubs which survived the harsh climatological and soil conditions were all eaten to the ground by antelope (Howard, et. al. 1979).

5. Topography

The importance of the microhabitats created by depressions, gullies, rock outcrops and other irregularities in the landscape cannot be over emphasized in the reclamation of a winter range. These irregularities create small pockets that trap snow and block the wind, thus creating microhabitats where soil moisture and average wind velocity may be more conducive to the initial establishment and continued survival of sagebrush and other plant species (Monsen 1980). Reclamation should not only include a return to the original slope and contour, but also the creation of depressions and other irregularities which are valuable features of a winter range (Bruns 1977). Slopes must be reclaimed just as steep as premining slopes to insure that the snow free conditions, so important to the winter range, are maintained. Without the slopes, snow may not blow free and sagebrush will not be available to the antelope. Of course, reclaiming these slopes would be even more difficult than reclaiming the level areas.

6. Reclamation Time

While the state of the art has not been demonstrated for shrub establishment, many techniques show promise in this area. The techniques show that fair success can be achieved on good soils with sufficient quantities of moisture. However, on poorer soils combined with lower quantities of moisture, success is more limited and a longer time period is needed for establishment of shrubs. Monsen (1980) cited an example in Idaho where it took 20 years for shrubs to become of sufficient number to be dominant. However, in order to achieve premining forage production by shrubs it will take an even longer period of time. Due to the broken topography on Red Rim, with the associated steeper slopes. Soil stabilization and the subsequent vegetation establishment will take longer than in an area with a more gentle relief.

Based on the observed revegetation at the coal mines in the Hanna basin, existing oil and gas pipelines, abandoned well pads, road cuts along existing highways, and discussions with individuals working in the reclamation field, we feel that 25-50 years is a reasonable reclamation time for a 50-75 percent restoration of premining carrying capacity. The area will not reach its full premining potential, however, for 50-100 years. In a special report by Weiner (1980) on western mines he indicates "...while all the companies plan to reclaim fully lands that they have disturbed, none has yet achieved totally successful reclamation."

V. ANTICIPATED IMPACTS ON WILDLIFE POPULATIONS SHOULD MINING OCCUR ON THE RED RIM TRACT

A. PRONGHORN ANTELOPE

1. Significant Factors Affecting Total Antelope Losses

a. Weather

The Red Rim antelope crucial winter range is considered the only area in the northern part of the Baggs DAU where forage and cover is available to antelope during a critically severe winter. However, during such a winter, the entire crucial range is not available to the animals at all times.

Highly variable patterns of snow accumulation determine the location and availability of forage and cover on the crucial winter range. The unpredictable direction, duration, and intensity of individual winter storms, combined with the effects of topography, are the cause of this variability. Consequently, the location of available forage and cover on the crucial winter range fluctuates not only from one critically severe winter to the next, but also within a particular winter. As a result of this phenomenon, mining of the crucial winter range would reduce the probability of adequate forage and cover being available to the animals at a time when it may be crucial to their survival.

b. Antelope Distribution and Fall Movements

As mentioned previously, the isolation of the Red Rim crucial winter range in the northern half of the Baggs DAU increases its significance to the Baggs herd. Antelope distribution within the DAU is not uniform. Available water is probably the most important factor determining distributions. As shown by the universities' study (p. 75, 1980 Annual Report), all antelope home ranges contained freshwater sources, where much of the antelope activity was concentrated. From an aerial strip census conducted in June, 1980 the universities' study estimated approximately 7,600 head in the northern half of the DAU. Fawns were not included in this count.

An aerial census conducted by BLM biologists in the summer, after fawn drop, showed approximately 6,300 antelope in the northern half of the DAU. This is approximately 54 percent of the prehunt DAU population estimated by the WGFD computer model. BLM aerial surveys during January 1981 showed over 7,000 antelope in the area north of Muddy Creek. This was approximately 77 percent of the post-harvest population estimated for the Baggs DAU at this time. In addition, the universities study has shown that very large numbers of antelope move through the Red Rim area in the fall.

As mentioned previously, a critically severe winter has a major effect on antelope mobility in addition to its effect on forage and cover availability. If a critically severe winter were to trap a significant proportion of the DAU population north of Muddy Creek, Red Rim may be crucial to the survival of substantially greater numbers of antelope than indicated by the critically severe winter of 1978-1979.

c. Success of Reclamation

Based on an analysis of the preliminary results of the Red Rim reclamation study, a tour of reclamation sites in the Hanna area, and a thorough literature review, the successful reclamation of the Red Rim tract for antelope crucial winter range is not possible in the short term (mine life). Reclaiming windswept slopes and ridgetops by establishing stands of big sagebrush within a reasonable time has not yet been demonstrated in areas of similar climatic conditions.

In the short term, premining carrying capacity could not be returned to a level where it would contribute significantly to antelope survival at present population levels during a critically severe winter.

Long range reclamation goals should be to approach shrub densities and grass and forb annual production as described in the 1980 Red Rim vegetative characterization prepared by RME.

d. Disturbance of Crucial Winter Range

Anticipated disturbance of crucial winter range is presented in Table 3, Projected Surface Disturbance on the Red Rim Coal Tract. Of the total disturbance on the tract, 74 percent will take place on the crucial winter range. This estimate is based on a large scale map of projected surface disturbance obtained from the 1977 Red Rim Mining Plan, prepared by a contractor for Energy Development Company.

Table 3

PROJECTED SURFACE DISTURBANCE ON THE RED RIM COAL TRACT

Location	Number of Disturbed Acres Red Rim SSA	 1977 Red Rim Project Mining Plan
Inside Antelope Crucial Winter Range	3,753	5,700
Outside Antelope Crucial Winter Range	1,319	1,969
Total Disturbance	5,072 1/	7,669 2/

1/ Based on Table 1.1-3. Red Rim Site Specific Analysis

2/ Based on Exhibit X, 1977 Red Rim Project Mining Plan.

e. Crucial Winter Range Made Unavailable

Fencing, associated with the attempt to reclaim the crucial winter range, would effectively eliminate antelope use of undisturbed islands of crucial winter range within areas being reclaimed. Assuming it takes 24 years to mine the winter range at the rate of disturbance presented in the Red Rim SSA, approximately one-fourth of these undisturbed islands would be unavailable for a total of 24 years. It is estimated that additional undisturbed islands of approximately 100 acres would be isolated between active mining operations. Table 4 presents the maximum estimated acreages of disturbed and undisturbed crucial winter range which would result from mining the tract. These maximum acreages would not be reached until the active mining operation disturbs the last acreage of crucial winter range near the end of the 24 year period.

Fencing of areas being reclaimed would be necessary. Howard, et. al. (1979), in a study of woody plant establishment at six mine reclamation sites in Colorado and Wyoming indicated that antelope ate all test species to ground level except those species with natural protective mechanisms.

Table 4

MAXIMUM ACRES OF CRUCIAL WINTER RANGE DISTURBED
OR MADE UNAVAILABLE FOR USE

	Red Rim SSA	1977 Red Rim Project Mining Plan
Maximum Disturbed Crucial Winter Range	3,753	5,700
Unavailable Crucial Winter Range	445[1]	625[2]
TOTAL	4,198	6,325
Rate of Disturbance on Crucial Winter Range	158[3]	238[4]

[1] Based on 345 acres of undisturbed crucial winter rnage fenced for a minimum of six years within areas being reclaimed and an additional estimate of 100 acres disturbed crucial winter range isolated between activie pit operations.

[2] Based on 525 acres of undisturbed crucial winter range fenced a minimum of six years within areas being reclaimed and an additional estimate of 100 acres disturbed crucial winter range isolated between activie pit operations.

[3] Based on Table 1.1-3 of the Red Rim SSA.

[4] Based on a projection of 200 to 250 acres disturbance per year in the 1977 Red Rim Project Mining Plan.

f. Barriers to Antelope Movement

Fencing reclamation sites would not only reduce available winter range, but would significantly impact the ability of antelope to move through or across the tract when trying to reach areas of available forage during a critically severe winter. Riddle and Oakley (1973) stated that in areas with fences, antelope mortality doubles. Furthermore, active mining operations, with the associated pits and highwalls, would also present a significant obstacle to movement.

2. Anticipated Antelope Losses

Estimating antelope losses with any degree of accuracy is extremely difficult. As discussed in the previous section, many of the factors influencing losses are unpredictable.

As a basis for estimating losses, the total number of animals dependent on the available habitat can be compared to the projected loss of habitat. Data presented in Table 4 indicates a maximum of 4,200 to 6,300 acres of crucial winter range may be unavailable near the end of mining activity on the crucial winter range. The amount of disturbed land back in production and the productivity of these lands is difficult to predict with confidence (see Section IV). The 4,200 to 6,300 acres would be 26 to 40 percent of the total available Red Rim crucial winter range (16,000 acres).

Therefore, approximately 26 to 40 percent of the crucial winter range carrying capacity would be unavailable. This means a 26 to 40 percent reduction of antelope numbers is necessary in order to avoid overstocking, which would subsequently lead to habitat deterioration and further losses of carrying capacity. Of the total base herd in the Baggs DAU, an estimated ~~2,350~~ 2400 head are dependent on Red Rim. Proper management of remaining crucial winter range on Red Rim would require a 26 to 40 percent reduction of these numbers, or an increased legal harvest which would reduce the size of the base herd by 625 to 960 antelope. In other words, a reduction of the WGFD 1985 DAU post-harvest objective of 7,200 antelope to a total of 6,240 to 6,575 head is indicated. Since disturbance of crucial winter range would proceed gradually at the rates specified in Table 4, decreasing the size of the base herd could be accomplished by gradually increasing the legal harvest until the base herd is reduced to the desired level. The base herd size could then be increased at a rate proportionate to reclaimed land productivity. This reduction of base herd size by 625 to 960 antelope does not represent the cumulative impact over the life of the mine. Cumulative losses would be the harvestable progeny produced by 625 to 960 antelope over the life of the mine plus the time required for reclamation. These are the minimum losses expected to occur using the most reliable available data. Additional losses could occur from mining activity and human disturbance.

During a critically severe winter, additional losses of antelope could occur as a result of the factors discussed in the previous section. These losses, which are not predictable, would reduce the size of the base herd below the 6,240 to 6,575 level; however, through a decrease in the legal harvest, if initiated by WGFD, the base herd level should increase back up to the 6,240 to 6,575 level within 2-3 years.

The WGFD has stated (in correspondence with the Rawlins District dated June 10, 1980) that the legal harvest will be increased once every 5 years in order to reduce and maintain the level of the base herd below the carrying capacity of the winter range. Furthermore, the WGFD intends to reduce the base herd by up to 1,600 animals, instead of the 625 to 960 specified above, in order to minimize additional losses which could occur in the severe winter.

B. ANTICIPATED LOSSES OF SAGE GROUSE

Sage grouse populations in the Red Rim area would suffer the loss of portions of a major wintering area. Unlike antelope, the unhampered mobility of displaced grouse would allow their movement to adjacent areas, assuming suitable alternative wintering areas are available. However, it is possible that sage grouse may be tied to specific wintering areas year after year. The Washakie Basin study (1980 Annual Report) found that no significant movement of grouse occurred between winter use areas. Furthermore, grouse which were radio-tagged on wintering areas in the 1979-1980 winter were found by the end of November 1980 near the winter ranges identified the previous winter. If traditional use of winter ranges does occur, the partial loss of a major wintering area could result in a population decline.

C. MULE DEER

Mining the Red Rim tract would result in the loss of approximately 50 percent of the mule deer crucial winter range. As with antelope, proper management would dictate reducing the base herd of 50-150 head down to 25-75 head. Cumulative losses would be the harvestable progeny of 25-75 head over the life of the mine plus the time required for reclamation. It is possible for small localized populations such as this one to be destabilized by the loss of so many individuals, resulting in a subsequent downward trend and the potential loss of the population from the area.

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NATIONAL WILDLIFE FEDERATION

NATURAL RESOURCE CLINIC
FLEMING LAW BUILDING
BOULDER, COLORADO 80309
303/492-6552

ROBERT J. GOLTEN
COUNSEL

FRANCES M. GREEN
COUNSEL

20 September 1982

Walter C. Ackerman, Administrator
Land Quality Division
Department of Environmental Quality
401 West 19th Street
Cheyenne, WY 82002

Re: Petition to Designate a 20,480 Acre Area,
Known as "Red Rim," as Unsuitable for
Surface Coal Mining Operations

Dear Mr. Ackerman:

Please consider this response as a supplement to our Petition of 7 May 1982.

In item 3 of our Petition, "Description of the Boundaries of the Area Covered by the Petition," Table 1, we described the private, non-federal lands in the proposed Red Rim coal lease tract in Carbon and Sweetwater Counties, Wyoming. In your letter of July 26, 1982, you state that our Petition failed to cover "an area for consideration" as possible fragile lands, because our petition did not include a description of the interspersed federal parcels that are also part of the wildlife habitat in question.

Accordingly, we wish to add the following sentence, as a second sentence, to item 3 of our Petition:

> The federal lands in the proposed Red Rim coal lease tract in Carbon and Sweetwater Counties, Wyoming, are listed in Table 1a.

Additionally, we wish to add the attached Table 1a immediately after Table 1 on page 2 of our Petition.

Thank you for your attention and continued patience.

Sincerely,

Howard Geduldig

Howard Geduldig, Legal Intern

dh

Attachment

cc: ✓Office of Surface Mining, Mills, WY
Rocky Mountain Energy, Inc.

Table 1a

Federal Lands on the Proposed Red Rim Coal Lease Tract

Location	Acres
T. 19 N., R. 90 W.	
sec. 4: W½, NE¼	480
sec. 6: E½NE¼, SW¼NE¼, W½SE¼	200
sec. 8: NE¼, E½NW¼, E½SW¼, SW¼SW¼, N½SE¼	440
sec. 18	640
sec. 30: W½, NE¼, NW¼SE¼	520
T. 19 N., R. 91 W.	
sec. 24	640
sec. 26: E½E½	160
T. 20 N., R. 89 W.	
sec. 4: W½	320
sec. 6	640
sec. 8: W½, NE¼	480
sec. 18	640
T. 20 N., R. 90 W.	
sec. 12: E½, SW¼, E½NW¼, SW¼NW¼	600
sec. 14: E½, SW¼, E½NW¼	560
sec. 22: E½, SW¼	480
sec. 24	640
sec. 26	640
sec. 28: SE¼, E½NE¼, SE¼SW¼	280
sec. 32: E½SE¼, SW¼SE¼	120
sec. 34	640
T. 21 N., R. 89 W.	
sec. 24: S½	320
sec. 26: E½, SW¼, SE¼NW¼	520
sec. 34: SE¼, E½NE¼, E½SW¼, SW¼SW¼	360
TOTAL	10,320

Source: Geological Survey, Conservation Division, 1979.

APPENDIX B

CORRESPONDENCE REGARDING PETITION EVENTS

THE STATE OF WYOMING
ED HERSCHLER
GOVERNOR

Department of Environmental Quality

LAND QUALITY DIVISION

431 WEST 19TH STREET
TELEPHONE 307-777-7756
CHEYENNE, WYOMING 82002

June 2, 1982

CERTIFIED MAIL

Mr. Robert J. Golten, Council
National Wildlife Federation
Natural Resource Clinic
Fleming Law Building
Boulder, CO 80309

RE: Petition to designate a 10,160 acre area, known as "Red Rim," as unsuitable for surface coal mining operations.

Dear Mr. Golten:

Pursuant to W.S. 35-11-425 and Chapter XVIII, Land Quality Division Rules and Regulations, I have reviewed the above-referenced designation petition and find:

1. The petition is incomplete in item 2, "Identification of Petitioners' Interest Which may be Adversely Affected." Under Chapter XVIII, Section 1 (5), the definition of "person having an interest which is or may be adversely affected" focuses on either use of an identified resource which may be adversely affected, (i e., pronghorn antelope), or ownership of property which may be adversely affected. In the petition you allege neither use of the antelope (such as visual, study, hunting, etc.) nor ownership of the property. Any group or person could artfully plead and prove an interest in wise management of natural resources and protection of important wildlife species. However, the concept of "standing" within the administrative and judicial process requires allegations demonstrating an interest (here, use or ownership) apart from the general public's interest in management and protection of resources. In fact, OSM recognizes that "[t]he linchpin of the standing cases is 'use'," 44 F.R. 14913 (March 13, 1979). Without allegations focusing at least on some type of use (or ownership), you have failed to qualify as a "person having an interest which is or may be adversely affected."

2. The part of the petition which relies on W.S. 35-11-425(b)(i), the mandatory designation criterion based on reclamation infeasibility, is denied as frivolous. The statute requires the Council to designate an area as unsuitable for all or certain types of surface coal mining operations "if it is determined that reclamation pursuant to the requirements of this act is not technologically and economically feasible...." (Emphasis added). This identical language also appears in 30 U.S.C. 1272(a)(2). Neither Federal nor State law requires that the postmining land use for the "Red Rim" area be wildlife habitat. A review of the Wyoming Environmental Quality Act will illustrate that all determinations of postmining land use are discretionary. See, W.S. 35-11-103(e)(i); 402(a)(i), (ii), (iv); 406(b), (b)(i), (b)(ii); and 415(b)(v). Although the regulatory requirements appear to favor restoration of wildlife habitat, considerable discretion is vested with the Administrator to approve an alternative postmining land use if wildlife habitat restoration is not possible or if private landowners request an alternative land use which would preclude use as wildlife habitat. See Chapter IV, Section 2.a.(2), Land Quality Division Rules and Regulations. Therefore, inasmuch as wildlife habitat is not a mandatory postmining land use, I must deny that part of the petition alleging that reclamation as required by the Act is not feasible.

The following items are merely suggestions for your consideration in any resubmittal:

1. Although the reclamation feasibility allegations are denied, you might consider retaining much of the supporting evidence contained in the petition to demonstrate that the operation cannot be designed to appropriately mitigate long-term adverse impacts on wildlife.

2. You might consider expanding the petition to include renewable resource lands. The State program departs from the OSM definitions by including "critical habitat for game species regulated by the Wyoming Department of Game and Fish" within the definition of "renewable resource lands" (Chapter XVIII, Section 1(6), Land Quality Division Rules and Regulations).

Thank you for your attention to these items.

Yours sincerely,

W. C. Ackerman

Walter C. Ackerman
Administrator

WCA:rjc

cc: Robert E. Sundin
Office of Surface Mining (Denver & Casper)
Rocky Mountain Energy
David D. Freudenthal
Weldon Caldbeck
Nancy Freudenthal
Robert Dorn
Terri Lorenzon

NATIONAL WILDLIFE FEDERATION

NATURAL RESOURCE CLINIC
FLEMING LAW BUILDING
BOULDER, COLORADO 80309
303/492-6552

ROBERT J. GOLTEN
COUNSEL

FRANCES M. GREEN
COUNSEL

6 July 1982

Mr. Walter C. Ackerman
Administrator
Land Quality Division
Department of Environmental
  Quality
401 West 19th Street
Cheyenne, WY 82002

Re: Petition to Designate a 10,160 Acre Area,
Known as "Red Rim," as Unsuitable for
Surface Coal Mining Operations

Dear Mr. Ackerman:

Please consider this response as a Supplement to our Petition of 7 May 1982.

1. In item 2 of our Petition, "Identification of Petitioners' Interest Which may be Adversely Affected," we asserted the interest of the Wyoming Wildlife Federation (WWF) and the National Wildlife Federation (NWF) "in the wise management of the nation's natural resources and in the protection of wildlife species important to the nation and State of Wyoming."

You found these allegations of "standing" insufficient for failure to allege "use of an identified resource which may be adversely affected" or "ownership of property which may be adversely affected."

Accordingly, we wish to add:

> Both organizations have an interest in the use of pronghorn which will be adversely affected by surface coal mining operations in the proposed Red Rim coal lease tract. Our members--there are 3156 members of NWF living in Wyoming and approximately 2800 individual and affiliate members of WWF--persistently and intently engage in uses, both consumptive (i.e., hunting) and non-consumptive (e.g., visual appreciation, study, photography, etc.).

2. In item 4, "Criteria on Which the Proposed Designation Rests," and item 5, "Facts Supporting the Criteria," we asserted that (i) under Wyo. Stat. § 35-11-425(b)(i)(Supp. 1981) designation of the 10,160 acre Red Rim area as unsuitable for surface coal mining operations was mandatory because "reclamation pursuant to the requirements of this act is not technologically and economically feasible" (emphasis added); (ii) applicable reclamation standards require restoration of the affected land to a condition capable of supporting its highest pre-mining uses; and (iii) these highest pre-mining uses included providing critical winter range for pronghorn.

You rejected this part of our petition, finding that the Wyoming Environmental Quality Act (the Act) and the Land Quality Division Rules and Regulations issued thereunder, while favoring restoration of wildlife habitat, vest considerable discretion with the Administrator to approve alternative post-mining land uses. You assert that "all determinations of postmining land use are discretionary," and that, accordingly, nothing in either the applicable statute or regulations requires restoration to wildlife habitat.

We respectfully take issue with your view that all determinations of post-mining land uses are discretionary. To the contrary, the DEQ regulations (at Chapter IV, Section 2(a).(1)) mandate that:

> Reclamation shall restore the land to a condition equal to or greater than the "highest previous use." The land, after reclamation, must be suitable for the previous use which was of the greatest economic or social value to the community area, or must have a use which is of more economic or social value than all of the other previous uses. (Emphasis added.)

While this provision permits the Administrator's approval of a post-mining land use alternative other than wildlife habitat in many instances, it would appear that such an alternative would be permissible only (in cases unlike this one) where wildlife habitat was not the highest previous use.

The two current (pre-mining) land uses of major economic and social importance on Red Rim are wildlife habitat and cattle grazing. The single "highest previous use"[1] of Red Rim would be as wildlife habitat for pronghorn. Average annual expenditures over the last five years on these pronghorn by both resident and non-resident hunters, attributable to Red Rim's non-federal land, are in excess of $50,000 per year.2/ In addition, there are important social values, including scientific and aesthetic values, associated with these pronghorn that cannot be readily expressed in economic terms. In contrast, the value of these lands for cattle grazing must rate second to wildlife habitat. The total value of production of cattle attributable to Red Rim's non-federal lands is computed as approximately $10,000 per annum.3/

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[1] Chapter 1, Section 2.(38) defines this term:

> "Highest previous use" means a sustainable use of the land which has the greatest economic values to the people of the area prior to the commencement of the mining operation.

In short, where, as here, wildlife habitat is the highest current use, Section 2.a.(1) is applicable and requires restoration to that highest use. As we are aware of no post-mining land use for Red Rim of greater economic or social value than the current uses, the limited discretion vested in the Administrator under Section 2.a.(1), permitting his approval of an alternative post-mining land use of greater economic or social value, is inapplicable. Therefore, reclamation under this Act must necessarily be directed to an end-use as critical wildlife habitat for pronghorn.4/ If such reclamation is not technologically or economically feasible--as, we submit, is the case--then the area must (and in this case should) be designated unsuitable for coal development.

2/ This figure is derived from communication with the Planning Division of the Wyoming Game and Fish Department.

3/ This figure is derived from personal communication with Dr. Gordon Kearl, Professor of Agricultural Economics, University of Wyoming.

4/ In our petition we also requested that the Environmental Quality Council exercise its discretionary power to designate Red Rim as unsuitable for surface coal mining operations under Wyo. Stat. § 35-11-425(b)(ii)(B)(Supp. 1981). You suggested our expanding our petition, requesting unsuitability designation for Red Rim under § 35-11-425(b)(ii)(C), permitting unsuitability designation where surface coal mining operations affect "renewable resource lands" resulting in potential loss or reduction of long-range productivity of food or fiber products. Recognizing (i) that the lands at issue are "renewable resource lands" under Chapter XVIII, Section 1.(6), Land Quality Division Rules and Regulations; (ii) that the facts support both criteria for the proposed designation; and (iii) that the relatively nominal role played by these lands in the production of food and fiber, we do not at this time choose to rely on this criteria.

Thank you for your attention.

Sincerely,

Howard Geduldig/dh

Howard Geduldig
Legal Intern

dh

cc: Office of Surface Mining, Mills, Wyoming
Rocky Mountain Energy, Inc.

THE STATE OF WYOMING

ED HERSCHLER
GOVERNOR

Department of Environmental Quality

LAND QUALITY DIVISION

401 WEST 19TH STREET TELEPHONE 307-777-7756 CHEYENNE, WYOMING 82002

July 26, 1982

Mr. Robert J. Golten, Council
National Wildlife Federation
Natural Resource Clinic
Fleming Law Building
Boulder, CO 80309

RE: Petition to Designate a 10,610 Acre Area Known as "[redacted], as Unsuitable for Surface Coal Mining Operations

Dear Mr. Golten:

Thank you for the letter of July 6, 1982, from Howard Geduldig, Legal Intern, on the above referenced petition. The noted addition to "Identification of Petitioners' Interest Which may be Adversely Affected" satisfies my concern on the need to identify some use of the resource by the petitioner which may be adversely affected by surface coal mining operations. Therefore, please regard Item #1 in my letter of June 2, 1982, as addressed.

With regard to Item #2 in my June 2nd letter, your difference of opinion on mandatory designation under W.S. 35-11-425(b)(i) remains a part of the record, but it does not alter my previous decision to deny that part of the petition alleging that reclamation is required by the Act is not feasible.

At this time I am in a quandary as to the proper handling of your petition. I expected your organization to file a similar petition with OSM in order to bring into the petition process, the remaining federal lands within the Red Rim area. I must assume that this filing will not be forthcoming.

The failure to file with OSM significantly affects your petition. A review of the definition of "fragile lands" indicates that any petition relying on this designation criterion must identify a geographic area containing the important resource that could be damaged by the coal mining operation. Chapter XVIII, Section 1(2). Your organization has failed to describe an area containing valuable wildlife habitat within paragraph 3, Table 1 of the petition. Rather, the wildlife habitat appears to contain the parcels identified in your petition,

together with a number of non-identified federal parcels. In short, your petition does not cover an area for consideration as possible fragile lands, the proper area for consideration covers the lands in your petition plus other non-identified federal lands.

I cannot address the designation process under W.S. 35-11-425, which is essentially a land area planning process, without a land area. A piecemeal approach relating more to land ownership patterns than to land area planning is an incorrect focus for the designation process. I certainly would not consider permitting a mine based on the land pattern you have identified. I see no reason to process a designation petition based on the same land identification.

Although authorized, I am reluctant to deny your petition as incomplete at this time. I believe the petition process is a valid means of increasing public participation as required by the State Program and federal law. To give the petition process some viability on intermingled federal and nonfederal lands, the Governor is requesting Secretary Watt to bring the intermingled federal lands within the Red Rim area into the State's designation process. See Governor's letter attached hereto. Should the Secretary decide not to enter the Red Rim petition process, I will reassess my options at that time.

Because of the difficulties generated by the lack of a defined land area, I am staying the thirty (30) day time period which would otherwise begin on July 8, 1982, for either accepting or rejecting the petition. The clock will begin when I receive a decision from the Secretary on the federal lands.

Thank you for your continued interest in the Red Rim area.

Sincerely,

W. C. Ackerman

W.C. Ackerman
Administrator

WCA:dlw
Attachment
cc: OSM (Denver and Casper)
Clark Bolser, RME
David D. Freudenthal

APPENDIX C

ACREAGES AND LOCATIONS FOR FEDERAL AND NON-FEDERAL PETITION-AREA LANDS

Table C-1.--Comparison of petition-area Federal lands acreages as listed by petitioners with OSM estimates

Location	Acreage estimates	
	Petition	OSM
T. 19 N., R. 90 W.:		
sec. 4: W½, NE¼	480	479.90
sec. 6: E½NE¼, SW¼NE¼, W½SE¼	200	200.47
sec. 8:[1] NE¼, E½NW¼,[2] SW¼SW¼, N½SE¼	360	360
sec. 18	640	639.12
sec. 30: W½, NE¼, NW¼SE¼	520	520.72
T. 19 N., R. 91 W.:		
sec. 24	640	640
sec. 26: E½E½	160	160
T. 20 N., R. 89 W.:		
sec. 4: W½[3]	320	293.60
sec. 6	640	354.21
sec. 8: W½, NE¼	480	480
sec. 18	640	480.87
T. 20 N., R. 90 W.:		
sec. 12: E½, SW¼, E¼NW¼, SW¼NW¼	600	560
sec. 14: E½, SW¼, E½NW¼	560	560
sec. 22: E½, SW¼	480	480
sec. 24	640	640
sec. 26	640	640
sec. 28: SE¼, E½NE¼, SE¼SW¼	280	280
sec. 32: E½SE¼, SW¼SE¼	120	120
sec. 34	640	640
T. 21 N., R. 89 W.:		
sec. 24: S½	320	320
sec. 26: E½, SW¼, SE¼NW¼	520	520
sec. 34: SE¼, E½NE¼, E½SW¼, SW¼SW¼	360	360
Total	10,320	9,728.89

[1] OSM eliminated E½SW¼ by petitioners as Federal lands after learning this land is in private ownership. It was added to table C-2.

[2] OSM changed petitioners' legal description from E¼NW¼ to E½NW¼ to correspond to acreage listed by petitioners.

[3] OSM changed petitioners' legal description from W¼ to W½ to correspond to acreage listed by petitioners.

Table C-2.--Comparison of petition-area non-Federal lands acreages as listed by petitioners with OSM estimates

Location	Acreage estimates	
	Petition	OSM
T. 19 N., R. 90 W.:		
sec. 3: NW¼	160	159.91
sec. 5	640	640.32
sec. 7: E½, SW¼, SE¼NW¼	520	521.14
sec. 8:[1] E½SW¼	80	80
sec. 9: NW¼	160	160
sec. 17: W½	320	320
sec. 19	640	639.40
T. 19 N., R. 91 W.:		
sec. 13: E½E½, SW¼SE¼	200	200
sec. 25	640	640
T. 20 N., R. 89 W.:		
sec. 5	640	480.84
sec. 7	640	474.32
sec. 9: NW¼	160	160
sec. 17: NW¼	160	160
sec. 19: W½	320	167.68
T. 20 N., R. 90 W.:		
sec. 1: SE¼, E½NE¼, SW¼NE¼	280	239
sec. 11: E½SE¼, SW¼SE¼	120	120
sec. 13	640	640
sec. 23	640	640
sec. 25	640	640
sec. 27	640	640
sec. 33	640	640
sec. 35: N½	320	320
T. 21 N., R. 89 W.:		
sec. 23: SE¼SE¼	40	40
sec. 25: W½, NW¼NE¼	360	360
sec. 35	640	640
Total	10,160	9,722.61

---

[1] OSM eliminated this land area from petitioners' Federal lands list (table C-1) and added it to this table after learning that this land is in private ownership.

APPENDIX D

VEGETATION STUDY METHODOLOGY

The following information is reproduced verbatim from "Vegetative Characterization of the Red Rim, Wyoming Study Area" (Rocky Mountain Energy Company, 1982b):

"To assess the vegetation in the Red Rim study area, both qualitative and quantitative data were collected. The methodology used to obtain the various data is described in detail below:

Vegetation Mapping

"Vegetation types were delineated with the aid of color aerial photographs on the scale of 1" = 1,000', using the color and textural differences of the types as a guide in mapping. Vegetation types of 2 acres or more were identified and delineated on acetate overlays overlying the photos.

"Vegetation types distinguished in mapping were determined, first, by the differences in physiognomic character of the type; second, by the dominant species present; and, third, by quantitative data. The vegetation types were "ground truthed," and then transferred to a topographic base map, using a Kail projector. Sample points were plotted on the final vegetation map (Plate 1).

Species List

"A species list was developed from a species list prepared by RME in 1979. In addition, monthly field visits were made to the site between June and September 1980. Additional species were collected, pressed, and later verified. Species collected during both years were verified by Dr. William Weber of the University of Colorado Museum.

Sample Locations

"A completely random sampling design was followed for locations of sample points. Random sample points were plotted, using a grid and picking X and Y coordinates from a random numbers table. For the riparian and meadow vegetation types, separate grid systems were used because of their small but continuous areas.

"Generally, simple sampling was used, and each random point became a single data point. However, in the mountain shrub vegetation type, a clustered sampling technique was used to facilitate sampling in the many small, discontinuous areas. At each sample location in mountain shrub, four sample points were established and the data later averaged to get a single data point.

"Sample points plotted on the map were located in the field, between July and September of 1980, and quantitatively sampled for cover, production, and density. The number of samples taken in each of the vegetation types is provided in Table 8.

Cover Sampling

"Line intercept sampling methodology was followed for measuring shrub and half-shrub canopy cover of major vegetation types. Gardner saltbush was the only half-shrub measured for line intercept, cover density, and production.

At each sample location, a 100-foot tape was used as a line transect. The tape was laid out along a random compass direction, then stretched and held tightly between two pieces of rebar at a selected height above the plants (Figure 1). The distance intercepted by the canopies of the different shrub species was measured and recorded. Interception was recorded only along one edge. Any interspace greater than 1/10' was excluded from the total measurement, and measured separately. Standing litter (decadent canopy cover) was also recoreded in the same way, although it was not included in the live canopy cover calculations.

"The above procedure was followed for all major vegetation types with the exception of the mountain shrub type. At each sample location in the mountain shrub types, four transects were randomly laid out and previous procedures followed along each transect.

"Slope, aspect, and orientation data were taken for each line transect. A clinometer and compass were used to obtain this information.

"Data on shrub vigor and height were also obtained from cover transects. Each shrub or Gardner saltbush that intercepted the line transect was examined for vigor. Vigor was an ocular estimate based on a scale of 0-4. 0 was standing litter (totally decadent); 1, greater than 75 percent decadent; 2, below average vigor; 3, average vigor; and, 4, above average vigor.

"Heights of all live shrubs and Gardner saltbush intersecting the line transect were measured to the nearest centimeter. Measurements were taken at the tallest vegetative part of the plant. Inflorescences were not included in the measurements (Figure 1).

Shrub Density

"After cover, vigor, and height data were taken, a belt transect was established to measure shrub density. Randomly laid cover transects were used for location of belt transects, each 100 ft x 3 ft in size (Figure 1). For all browse species (both shrubs and Gardner saltbush) the number of live plants rooted within a belt transect was counted and recorded. The same procedure was followed for all sample locations in the various vegetation types. The only exception was in the mountain shrub vegetation type where a clustered sampling technique was followed. Four belt transects were located at each sample location.

Productivity Sampling

"Productivity measurements were obtained for forbs, grass, and grasslike species only. The current year's growth was harvested from within each randomly located quadrat. One meter square (1 m x 1 m) quadrats were used for productivity sampling in sage, sagegrass, saltbush, mountain shrub, and greasewood vegetation types. One-quarter of a meter square (50 cm x 50 cm) quadrats were used in riparian, grass, and meadow vegetation types.

"In sage, sagegrass, saltbush, mountain shrub, and greasewood vegetation types a 1 m x 1 m quadrat was randomly placed on a line transect. The same procedure was followed for the riparian vegetation type, but with a 50 cm x 50 cm quadrat. In the grassland and meadow types, no transects were used because of the absence of shrubs. Quadrats, 50 cm x 50 cm, were used to obtain production data.

"Species were clipped at ground level, and separated by life forms, grasses or forbs. Grasslike species were combined with grasses. Samples were oven-dried at 105°C for at least 24 hours and weighed to the nearest tenth of a gram.

"In the mountain shrub vegetation type, a 1 m x 1 m quadrat was randomly located on each of the four transects, and the above clipping procedure followed.

"Before clipping, half-shrub cover within the randomly placed quadrat was ocularly estimated. Grass, grasslike, and forb species present in the quadrat were recorded for frequency calculations.

Data Calculations

"For each sample location, canopy cover value was determined for live and decadent shrubs and Gardner saltbush. Total interceptions were tallied for each species. The mean live cover, as well as the mean decadent cover, for each browse species was calculated for all vegetation types and expressed as a percentage. Percent canopy cover for each species was calculated by the following formula:

% Canopy Cover = Total Transect Length / Total of All Intercept Lengths x 100.

"In the clustered sampling procedure, mean cover value for each sample location was determined by computing the mean of the four transects sampled.

"Total production for each plot was calculated as total weight of all grasses, grasslike plants, and forbs, in grams per square meter or grams per 0.25 square meter. Production was expressed in pounds per acre by multiplying grams per meter squared with 8.93 or 35.6, respectively.

"In the clustered sampling procedure, mean production for a sample location was determined by computing the mean of the four quadrats clipped.

"Density was determined by totaling all half-shrubs and shrubs rooted within each belt transect. Number of shrubs within a belt transect was converted to density per acre by multiplying with appropriate conversion factors (Table 6).

"Sample adequacy for cover, production, and shrub density was obtained by using the following sample adequacy equation:

$$n_{\min} = \frac{2\,(sz)^2}{(d\bar{x})^2},$$

where:

n_{min} = minimum number of quadrats or transects to measure in a vegetative type.

s = sample standard deviation.

z = the z statistic.

d = amount of reduction desired to detect.

$\bar{x}$ = sample mean of production, cover, and density per quadrat or transect.

"Sample adequacy calculation was done with statistical confidence level of 80% and 10% reduction in the mean.

"Sample adequacy calculations were based on data obtained from all sample locations. Mean ($\bar{x}$) and standard deviation (s) for cover, production, and shrub density used in the equation were obtained by calculating the mean of all sample locations within a vegetation type.

"Sample adequacy for the mountain shrub type was determined as above except that the cluster sampling technique was utilized (Cochran, 1966)."

APPENDIX E

DESCRIPTION OF EXISTING PETITION-AREA PLANT COMMUNITIES

A broad classificational system to allow description of the existing onsite plant community types is used here. The salt desert shrub-dominated (Atriplex and greasewood) community types are separated from the northern desert-dominated (sagebrush) communities. Additionally, the mountain shrub types are separated, albeit arbitrarily, from the northern desert types. The vegetation data base is limited, but inclusion of the descriptions of these types is necessary to evaluate the existing information from the site and to make some comparisons with the literature. The accumulation and evaluation of this data is required to make some judgments concerning the petition allegations.

Selected sections from the vegetation inventories done by RME (1982b) and BLM and others (1976) at its EMRIA site are included. Figures E-1 through E-5 show selected sections from the RME (1982b) inventory. Figure E-6 is one of the sections inventoried by BLM. Acreages measured for each community type are found on each figure. The quality of the inventory, reviewed earlier, suggested that publication of the full inventory was not worthwhile. The sections of the inventory which are included give a very general indication of the complexity of vegetative types within the landscape and the positions in which they are generally found. Table E-1 lists the acreages for each of the vegetative types summarized for the area sampled. The latter will provide something of a representative figure for the distribution of vegetative types in the tract. BLM's EMRIA site is located in the extreme southwestern end of the petition area and the soil-vegetation units in this area differ significantly from those in the areas north and east of Separation Creek.

The two broad divisions within the salt desert shrub type which were recognized by RME (1892b) are the saltbush and greasewood types. Descriptions of the inventory and methods used appear in appendix D. Descriptions of the various plant communities which have been recognized or are thought to be of importance in the tract are now presented.

A. GREASEWOOD-DOMINATED COMMUNITY TYPES

Greasewood-dominated plant communities (Sarcobatus vermiculatus) are widespread throughout the Western United States. They frequently occur on alluvial flood plains and terrace-flood plain systems but also occur in the upland position where soils and bedrock materials are fine textured and contain large quantities of soluble salts, exchangeable sodium, or both. Rydberg (1969) described the range of the species to be on alkaline flats from Saskatchewan to Texas and from California to Washington. Anderson (1980) described the community as occurring on many areas where the soil is heavy and alkaline. The description of the mapping unit identified by RME (1982b) during its inventory of the shrubs on the site follows:

> **Greasewood**
>
> "The greasewood vegetation type encompasses large areas of the northern portion of the study area. Soils are saline-alkaline with generally level slopes, less than 2 percent. During the spring rains, this area is often flooded.
>
> "The dominant shrub in this vegetation type is greasewood (Sarcobatus vermiculatus). Shrubs associated with greasewood

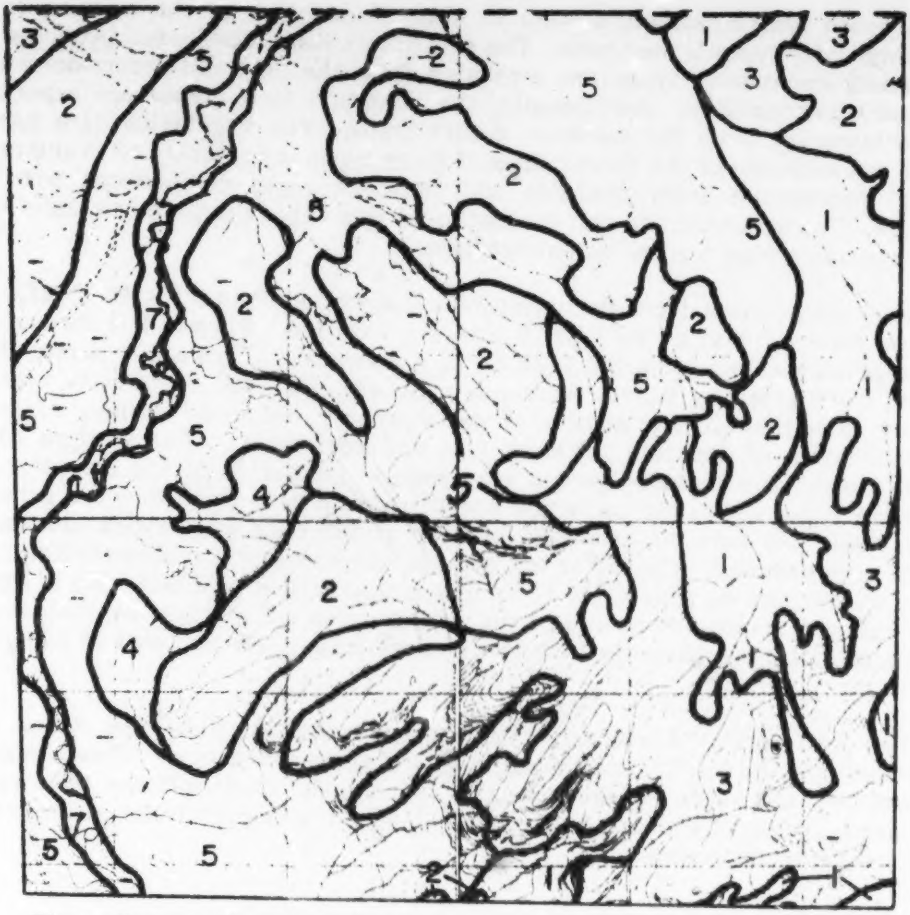
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Figure E-1.--RME vegetation inventory for sec. 5, T. 19 N., R. 90 W. (Rocky Mountain Energy Company, 1982b).

Vegetation-map legend and acreages for the above area.

Inventory No. and vegetation type	Acreage	Percentage of total
1 Sage	83.8	13.4
2 Sage-grass	137.6	21.9
3 Grass	114.9	18.3
4 Saltbush	15.5	2.5
5 Greasewood	252.0	40.2
7 Riparian	23.8	3.8
Total	627.6	

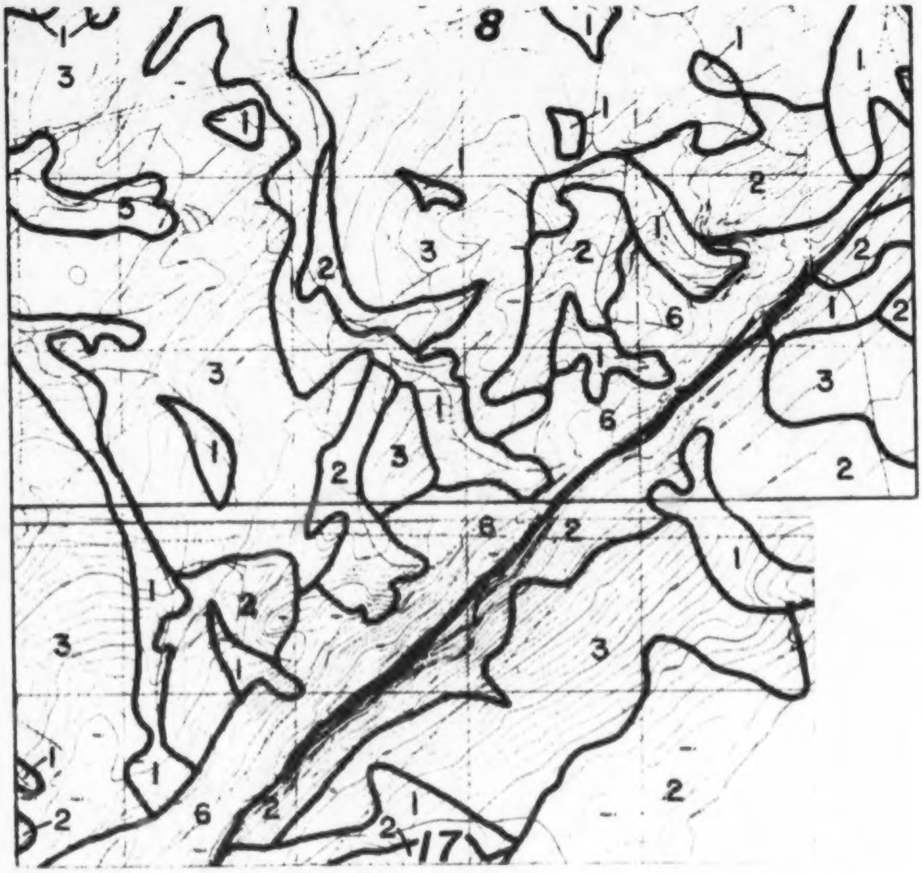

Figure E-2.--RME vegetation inventory for portions of secs. 8 and 17, T. 20 N., R. 89 W. (Rocky Mountain Energy Company, 1982b).

Vegetation-map legend and acreages for the above area.

Inventory No. and vegetation type	Acreage	Percentage of total
1 Sage	87.4	15.5
2 Sage-grass	137.7	24.4
3 Grass	271.7	48.1
5 Greasewood	6.6	1.2
6 Mountain shrub	61.0	10.8
Total	564.4	

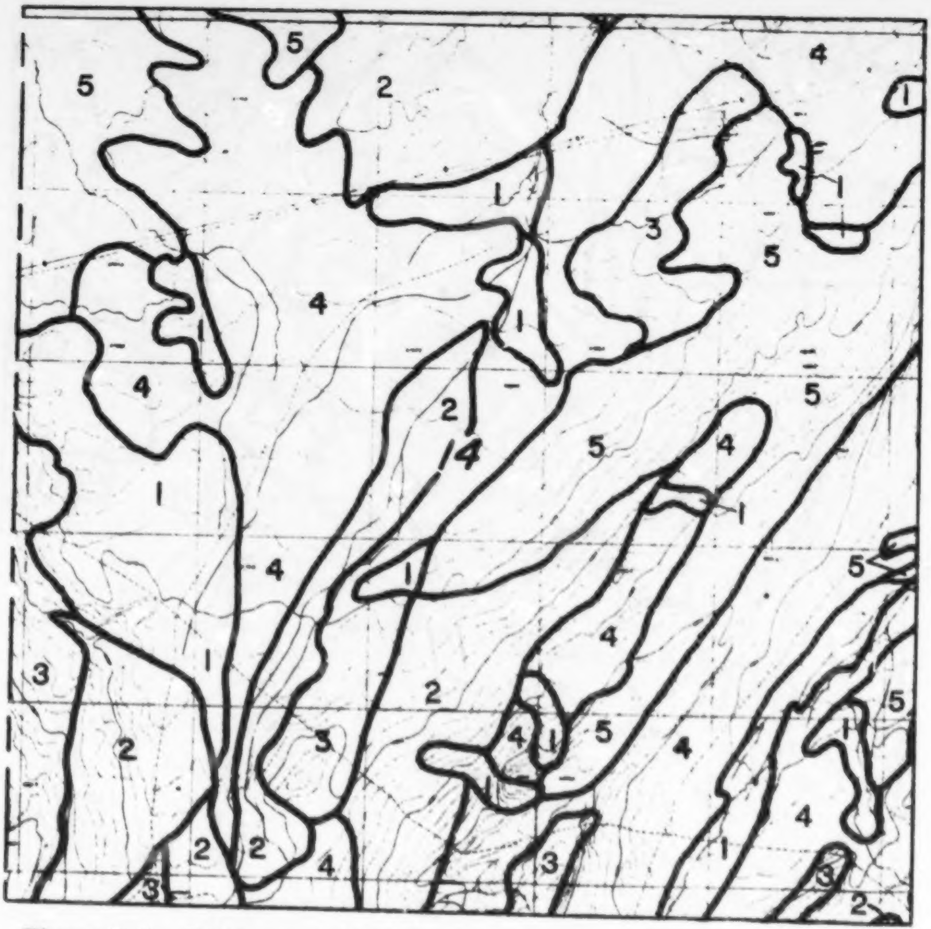
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Figure E-3.--RME vegetation inventory for sec. 14, T. 20 N., R. 90 W. (Rocky Mountain Energy Company, 1982b).

Vegetation-map legend and acreages for the above area.

Inventory No. and vegetation type	Acreage	Percentage of total
1 Sage	76.1	14.3
2 Sage-grass	116.2	21.9
3 Grass	67.8	12.8
4 Saltbush	240.9	45.4
5 Greasewood	29.9	5.6
Total	530.9	

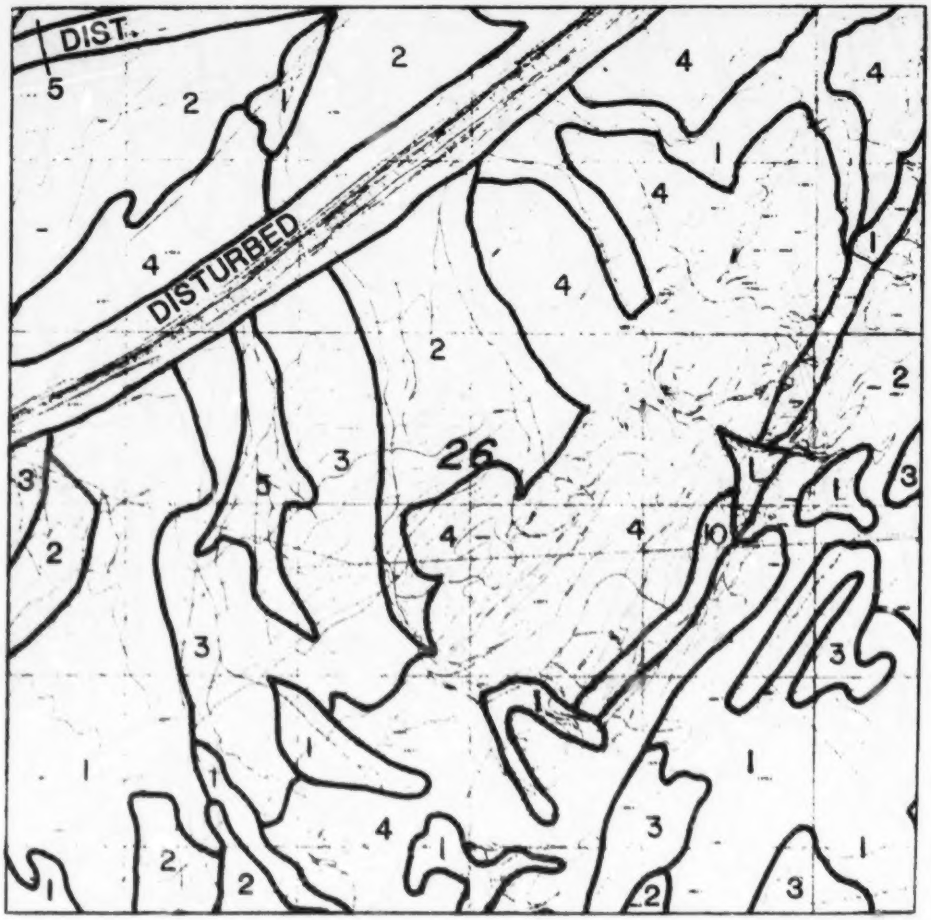

Figure E-4.--RME vegetation inventory for sec. 26, T. 21 N., R. 89 W. (Rocky Mountain Energy Company, 1982b).

Vegetation-map legend and acreages for the above area.

Inventory No. and vegetation type	Acreage	Percentage of total
1 Sage	172.2	27.3
2 Sage-grass	104.9	16.6
3 Grass	82.0	13.0
4 Saltbush	200.9	31.9
5 Greasewood	11.8	1.9
10 Barren	10.9	1.7
Disturbed	47.6	7.6
Total	630.3	

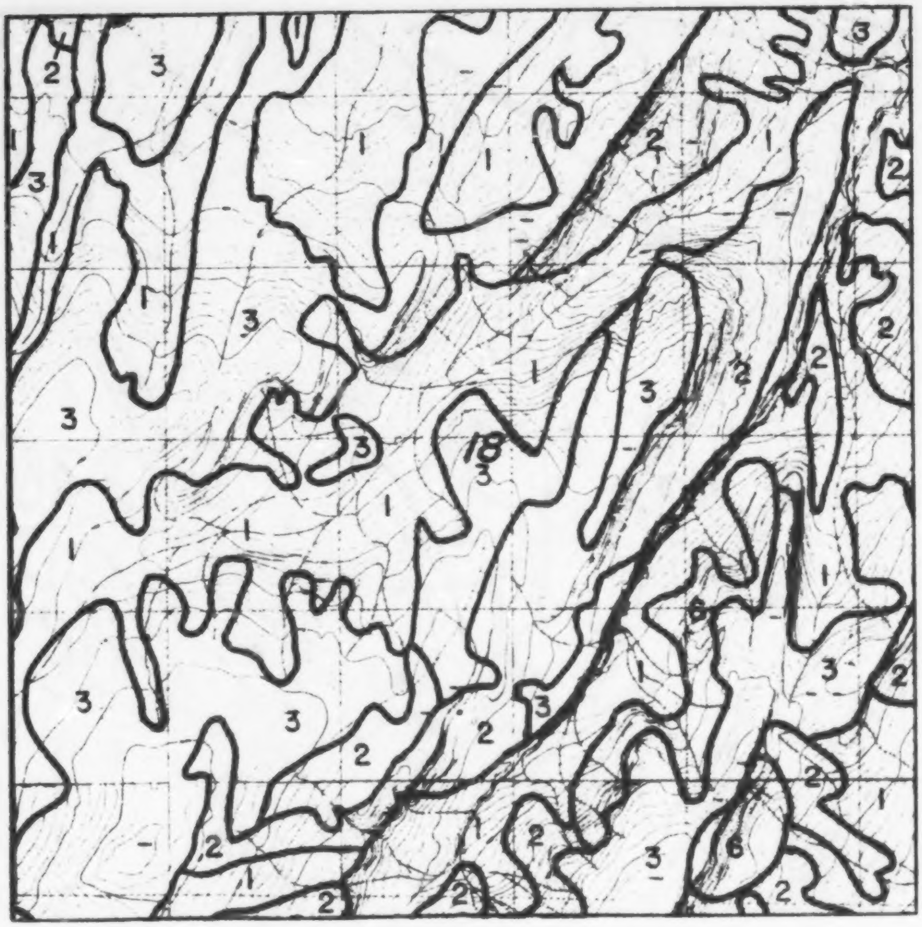
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Figure E-5.--RME vegetation inventory for sec. 18, T. 19 N., R. 90 W. (Rocky Mountain Energy Company, 1982b).

Vegetation-map legend and acreages for the above area.

Inventory No. and vegetation type	Acreage	Percentage of total
1 Sage	238.5	38.9
2 Sage-grass	119.0	19.4
3 Grass	232.8	38.0
6 Mountain shrub	22.2	3.6
Total	612.5	

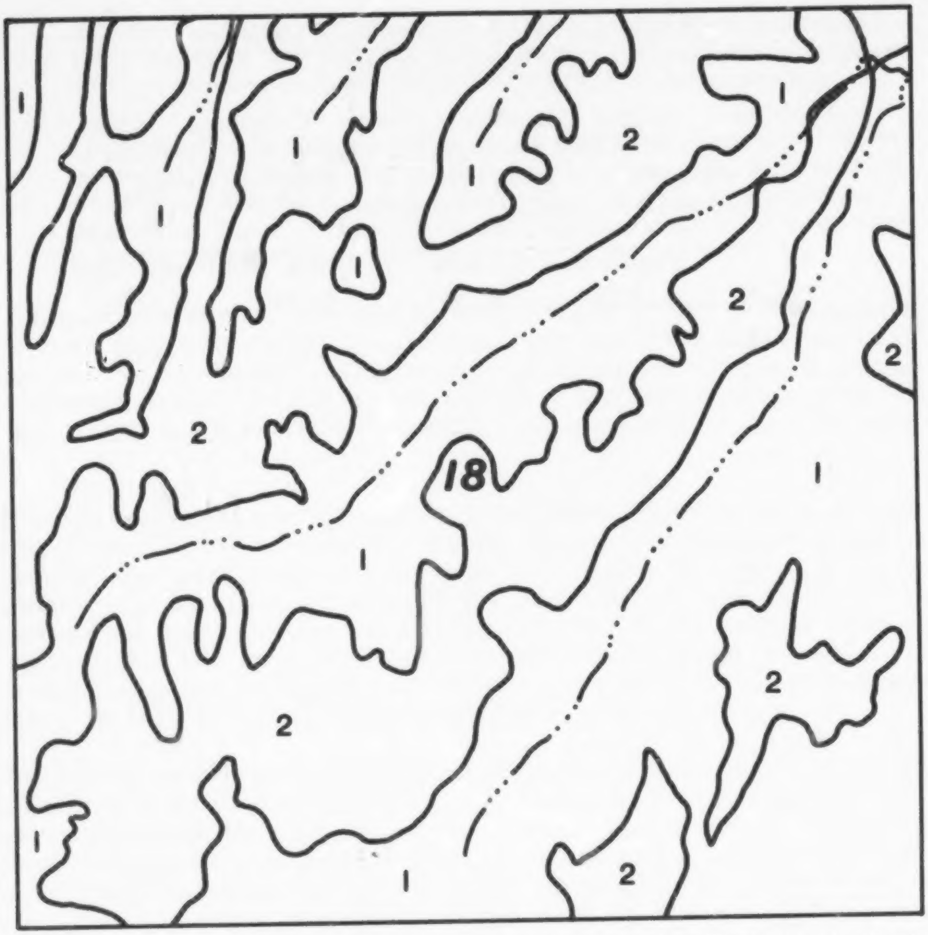


Figure E-6.--EMRIA vegetation inventory for sec. 18, T. 19 N., R. 90 W. (Bureau of Land Management and others, 1976).

Vegetation-map legend and acreages for the above area.

Inventory No. and vegetation type	Acreage	Percentage of total
1 Sage	288.8	45.8
2 Sage-grass	342.3	54.2
Total	631.1	

Table E-1.--Red Rim vegetation summary for sample sections

(Source: Rocky Mountain Energy Company, 1982b. Vegetation type: 1 = sage; 2 = sage-grass; 3 = grass; 4 = saltbush; 5 = greasewood; 6 = mountain shrub; 7 = riparian; 9 = meadow; 10 = barren)

Section	Vegetation type	Subtotal (acres)	Total (acres)	Percentage of total
18	1	238	656	22.2
14	1	76		
8 and 17	1	87		
5	1	83		
26	1	172		
18	2	119	613	20.7
14	2	116		
8 and 17	2	137		
5	2	137		
26	2	104		
18	3	233	768	26.0
14	3	67		
8 and 17	3	271		
5	3	115		
26	3	82		
14	4	241	456	15.4
5	4	15		
26	4	200		
14	5	30	301	10.2
8 and 17	5	7		
5	5	252		
26	5	12		
18	6	22	82	2.8
8 and 17	6	60		
5	7	24	24	0.8
26	10	11	11	0.4
26	([1])	48	48	1.6
	Total		**2,959**	

---

[1] Disturbed.

> include big sagebrush, shadscale saltbush, cottonthorn horsebrush, spiny hopsage, and Douglas rabbitbrush. Half-shrubs associated with greasewood include Gardner saltbush and bud sagebrush.
>
> "The understory consists primarily of perennial grasses and some perennial and annual forbs. Squirreltail, bluegrass, and western wheatgrass are the common grasses that occur in the greasewood vegetation type. The common forb species are Hoods phlox and goosefoot (Chenopodium spp.)."

The quantitative data collected by RME (1982b), subject to the conditions or qualifications described earlier, are found in table E-2. The broad nature of the mapping units as described by RME is apparent from the number of species and density of shrub species. Of critical importance to the petition is the total number of shrubs--12,163 per acre and the density of big sagebrush (subspecies unknown), 2,076.

Branson (Bureau of Land Management and others, 1976) recognized in the Red Rim EMRIA study area an important subtype of the greasewood-dominated plant communities--the greasewood and big sagebrush type--for which the cover and productivity data are found in table E-3. Such subtypes are found in several locations on the tract and are of considerable importance both to reclamation planning activities and to assessment of antelope food habitat potential. Characterization data from the Hanna Basin EMRIA study (Bureau of Land Management and others, 1975) for the greasewood community type is in table E-4.

Brief field studies on the Red Rim tract and experience in the transition-complex of salt desert and northern desert shrub formations would suggest that this community occurs on the alluvial fans and terraces, where relatively high soluble salt concentrations are encountered. The presence of these substances in such soils results from high concentrations in the parent materials or by accumulation in the greasewood plant of either soluble salts or sodium which produce a suitable edaphic environment for this species. Similar community types can occur on the upland pediment slopes where the big sagebrush and greasewood community type or the more restricted greasewood type develops where the composition of bedrock strata allows either the mixture of the two species or the Greasewood type to develop. The relatively high cover figures for the Red Rim EMRIA tract suggest that these types are found mostly in the alluvial fan position. The major differences in cover between the BLM and others (1976) and the RME (1982b) data suggest the large edaphic differences between the northeastern and southwestern sections of the tract.

The data from the Arch Mineral Corporation's Seminoe No. 2 mining and reclamation plan application (Arch Mineral Corporation, 1981b) is found in table E-5. The cover figures are reduced significantly from those of the EMRIA study and probably reflect the rather mesic conditions found in the southwesternmost portion of the Red Rim tract. The presence of silver sagebrush (Artemisia cana) and the two Chrysothamnus species--viscidiflorus and nauseosus--would indicate a rather broadly defined unit being utilized on the Seminoe No. 2 study. Mine Reclamation Consultants (1977) suggest the community type is generally confined to saline soils in draws or on flood plains where soluble salts have accumulated. (Note: A vegetation study by Mariah Associates, Inc., submitted by Arch Mineral Corporation to Wyoming DEQ in April 1983 will replace the Mine Reclamation Consultants' (1977) study.) Where the soluble salts and/or sodium concentrations

Table E-2.--Characterization of the greasewood vegetation type in the Red Rim, Wyoming, study area

(Source: Rocky Mountain Energy Company, 1982b)

Plant species	Mean shrub height (inches)	Line-intercept canopy cover (percent)	Line-intercept litter cover (percent)	Frequency among transects (percent)	Shrub density per acre	1980 production (lb/acre)
Shrubs:						
Artemisia tridentata	32.15	4.18	4.8	87.9	2,076	----
Atriplex confertifolia	46.3	0.05	----	3.0	73	----
Atriplex gardneri	8.58	3.18	----	75.8	5,881	----
Chrysothamnus viscidiflorous	24.02	0.48	----	15.2	218	----
Grayia spinosa	38.68	0.65	0.1	15.2	305	----
Sarcobatus vermiculatus	43.33	12.15	1.1	97.0	3,601	----
Tetradymia spinosa	31.15	0.06	----	6.1	9	----
	32.03	20.75	6.0		12,163	
					Grass	109.8
					Forbs	8.9
					Total	118.7

Numbers of plots: Shrub canopy cover = 33; production = 34; shrub density = 24.

Table E-3.--Cover and production data for the greasewood-big sagebrush community type from BLM's EMRIA site

(Source: Bureau of Land Management and others, 1976)

	Percentage cover	Yield (lb/acre)
Artemisia tridentata	26.0	662.5
Atriplex confertifolia	1.3	105.0
Gutierrezia sarothrae	0.7	----
Sarcobatus vermiculatus	22.0	435.0
Agropyron smithii	5.7	7.0
Sitanion hystrix	3.4	30.5
Lappula sp.	0.3	1.0
Sisymbrium sp.	1.3	2.5
Unidentified forbs	0.3	----
Live cover and total vegetation yield	61.0	1,243.5
Mulch	29.0	2,936.0
Bare	9.0	----
Rock	0.3	----

Table E-4.--Percentage cover of vegetation, mulch, and bare soil for the greasewood community type on the Hanna Basin coal field study site

(Source: Bureau of Land Management and others, 1975)

Genus and species	Common name	Percentage cover
Shrubs:		
Artemisia tridentata	Big sagebrush	1.3
Atriplex nuttallii	Nuttall saltbush	8.0
Sarcobatus vermiculatus	Greasewood	35.2
Grasses and grass-like:		
Agropyron smithii	Western wheatgrass	11.2
Poa secunda	Sandberg bluegrass	3.5
Sitanion hystrix	Squirreltail	0.8
Mulch		15.8
Bare soil		24.2

Table E-5.--Arch Mineral Corporation's Seminoe No. 2 mine cover and yield data for the greasewood-big sagebrush community type

(Source: Mine Reclamation Consultants, 1977)

Cover data	
Perennials	Average (percent)
Grasses:	
Agropyron dasystachyum (Hook.) Scr	1.60
Agropyron smithii Rydb.	(tr)
Calamovilfa longifolia (Hook.) Scr	.04
Elymus cinereus Scribn. and Mer	1.05
Oryzopsis hymenoides (Roem.) Schu	.46
Poa fendleriana (Stund.) Vasey	.25
Poa pratensis L.	(tr)
Poa secunda Presl	2.38
Sitanion hystrix (Nutt.) J. G. Smi	1.96
Total	7.74
Forbs:	
Allium textile A. Nels. and MacBr.	(tr)
Arenaria hookeri Nutt.	0.04
Cirsium spp. Hill	.04
Erigeron pumilus Nutt.	.21
Grindelia squarrosa (Pursh) Dunal	.03
Machaeranthera glabriuscula (Nutt.)	.13
Other	(tr)
Phlox hoodii Richards	.02
Taraxacum officinale Weber	.02
Trifolium spp. L.	.01
Vicia americana Muh.	(tr)
Total	0.51
Half shrubs:	
Artemisia spinescens Dc.	0.54
Atriplex Nuttallii Wats. (*Atriplex*)	2.23
Total	2.77
Shrubs:	
Artemisia cana Pursh	0.01
Artemisia tridentata Nutt. var. *tr*	5.66
Atriplex confertifolia (Torr. and	.17
Chrysothamnus nauseosus (Pallus) B	.16
Chrysothamnus viscidiflorus (Hook.)	.16
Sarcobatus vermiculatus (Hook.) Em	8.29
Total	14.45

Table E-5.--Arch Mineral Corporation's Seminoe No. 2 mine cover and yield data for the greasewood-big sagebrush community type--Continued

Cover data--Continued

Perennials	Average (percent)
Succulents:	
Coryphantha vivipara (Nutt.) Britt	(tr)
Opuntia polyacantha Haw.	1.06
Total	1.06
Total perennials	26.53

Annuals	Average (percent)
Annual grasses:	
Bromus tectorum L.	0.04
Total	0.04
Annual forbs:	
Miscellaneous	0.41
Total	0.41
Total annuals	0.46
Grand total	26.98

Other	Average (percent)
Rocks	0.19
Litter	36.93
Bare ground	37.49
Vegetation	25.39
Grand total	100.00

Table E-5.--Arch Mineral Corporation's Seminoe No. 2 mine cover and yield data for the greasewood-big sagebrush community type--Continued

Yield data	
Perennials	Average (pounds per acre)
Grasses:	
Agropyron dasytachyum (Hook.) Scr	6.72
Elymus spp. L.	74.37
Other	7.61
Poa fendleriana (Stund.) Vasey	.14
Poa secunda Presl	.16
Total	89.01
Forbs:	
Other	1.21
Total	1.21
Half shrubs:	
Atriplex nuttallii Wats. (*Atriplex*)	5.63
Other	.34
Total	5.97
Shrubs:	
Artemisia tridentata Nutt. var. *tr*	27.65
Sarcobatus vermiculatus (Hook.) Em	86.86
Total	114.51
Total perennials	210.71
Annuals	Average (pounds per acre)
Annual grasses:	
Bromus tectorum L.	0.09
Total	0.09
Total annuals	0.09
Grand total	210.80

are less, the greasewood occurs in association with big sagebrush. On the Seminoe No. 2 site, the areas above the greasewood-big sagebrush type are bordered by a big sagebrush type.

Several subtypes or divisions in the greasewood community types would be recognized during the premine vegetative inventory. Some of the units identified during field examinations would include the greasewood, greasewood and basin big sagebrush, greasewood and Wyoming big sagebrush, and greasewood escarpment types. Certainly, the identification of the types will be dependent upon careful objective analysis of field data. Greasewood communities were observed in the ridge and valley, as well as the more rolling uplands, on the Red Rim tract. This unit will have to be carefully studied and evaluated in reference to the greasewood type identified and described by RME (1982b) which they appear to have identified and described, at least initially, in the alluvial fans and low terraces.

In summary, the Greasewood communities in this area are generally found on sites characterized as having relatively high osmotic pressures. The soils are often moderately fine and fine textured, with significant concentrations of soluble salts or sodium. They are predominantly found in the flood plain or terrace position but are encountered in upland swales or residual saline/sodic shale outcrops. The absolute cover values are low when compared to the grassland types from the southwestern portion of the petition area. The suitability of soil materials associated with this community would be poor or unsuited for reclamation. Reseeding soil materials from this type with halophytes, such as shadscale or fourwing saltbush, would be required.

B. ATRIPLEX-DOMINATED COMMUNITY TYPES

Hitchcock (1964) reported that well over 100 species of Atriplex have been identified and are widely distributed. They are most abundant in drier, desert or semidesert areas, or moderately to strongly saline or alkaline soil. Several of the shrubby species are valuable browse plants in arid regions of Western North America.

The Atriplex community types are dominated by three species--Gardner saltbush (Atriplex gardneri), fourwing saltbush (Atriplex canescens), and shadscale (Atriplex confertifolia). On the Red Rim site they occupy some of the more saline and alkaline portions of the alluvial fans and are encountered on the moderately deep and deep upland soils having similar chemical and physical characteristics. The fourwing saltbush is highly palatable to herbivores and is important to wildlife species in many locations in the West. It is also utilized extensively by livestock. The primary distribution of the communities occurs along Separation Creek and in the uplands in the northeastern portion of the tract (RME, 1982b). The RME data for this community type appears in table E-6. Branson did not recognize this type in the EMRIA study nor did Arch Minerals at the Seminoe No. 2 site. The RME descriptions of the vegetative type follows:

Saltbush

> "Being an important antelope winter browse species, Gardner saltbush was the only half-shrub sampled in the vegetation study. The saltbush vegetation type encompasses three areas on the Red Rim study area: a large flat portion of the northern half of the

Table E-6.--Characterization of the saltbush vegetation type in the Red Rim, Wyoming, study area

(Source: Rocky Mountain Energy Company, 1982b)

Plant species	Mean shrub height (inches)	Line-intercept canopy cover (percent)	Line-intercept litter cover (percent)	Frequency among transects (percent)	Cover quadrats (percent)	Frequency by quadrats (percent)	Shrub density per acre	1980 production (lb/acre)
Shrubs:								
Artemisia tridentata	20.8	0.68	0.4	39.7	1.4	----	290	----
Atriplex confertifolia	26.0	0.02	----	1.6	1.4	----	44	----
Atriplex gardneri	5.3	6.86	0.1	98.4	9.4	----	15,493	----
Chrysothamnus nauseosus	49.0	----	(*)	1.6	1.4	----	15	----
Chrysothamnus viscidiflorous	11.3	0.20	----	17.5	----	----	348	----
Grayia spinosa	----	----	----	----	----	----	3	----
Sarcobatus vermiculatus	23.6	0.09	----	1.6	----	----	58	----
Tetradymia spinosa	9.5	0.03	----	6.3	----	----	15	----
Totals	20.5	7.88	0.5	----	----	----	16,266	----
Half-Shrubs:								
Artemisia pedatifida	----	----	----	----	1.4	22.7	----	----
Artemisia spinescens	----	----	----	----	1.4	36.1	----	----
Atriplex gardneri	----	----	----	----	9.4	80.4	----	----
Ceratoides lanata	----	----	----	----	1.4	25.8	----	----
Totals					13.6			
							Grass	79.5
							Forbs	7.1
							Total	86.6

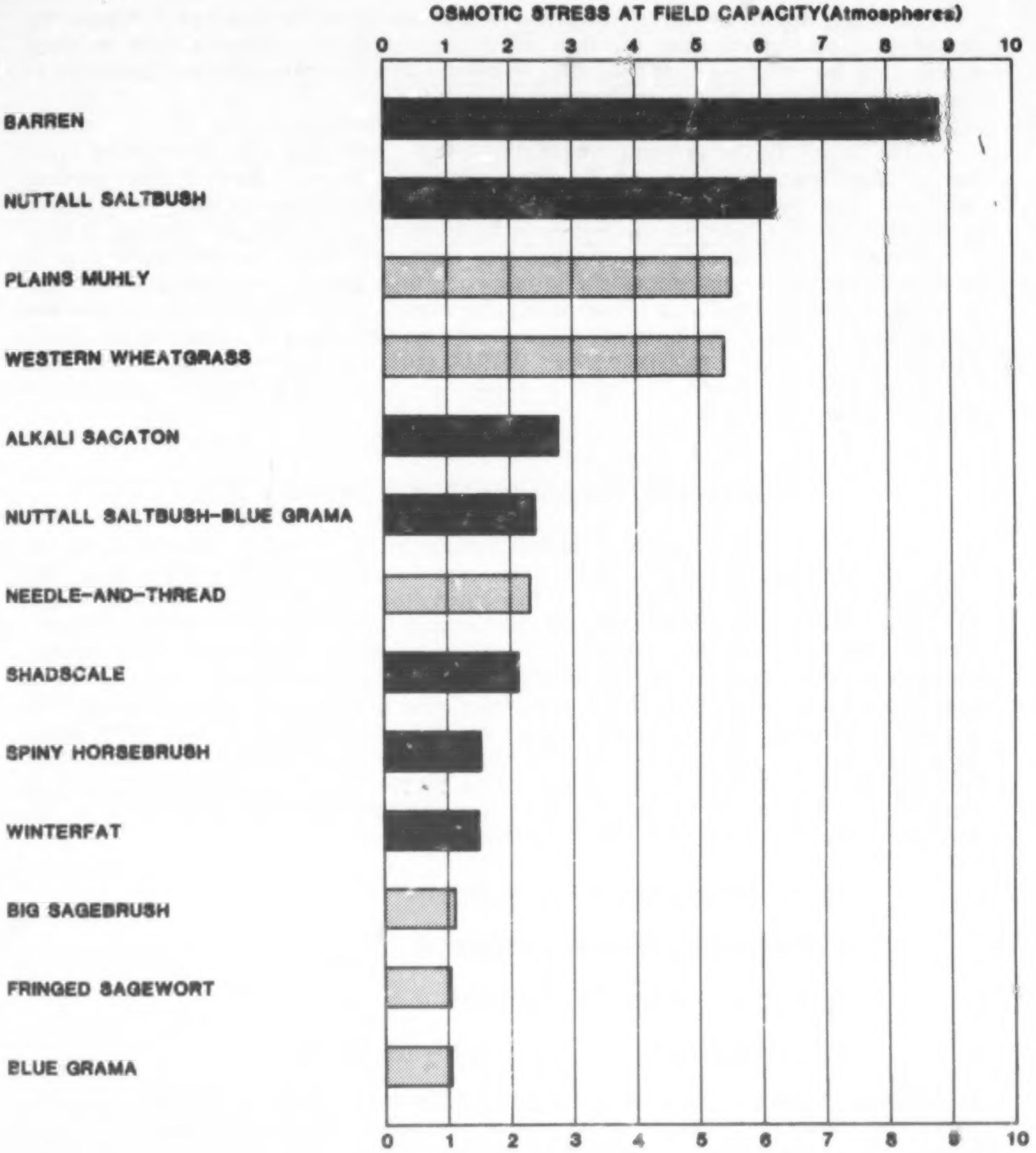
(*) = Trace.
Numbers of plots: Shrub canopy cover = 63; production = 97; shrub density = 54.

> area; small patchy areas in the south; and a long shale outcrop strip that runs parallel to the Red Rim escarpment in the northern half of the study area. Soils are variable, generally being clayey to slightly saline except on the outcrop ridge which is shale. The slope ranges from 0 to 20 percent being steeper on the shale ridge (10-20 percent) and moderately level (0-5 percent) on the other two areas.
>
> "The dominant vegetation type is Gardner saltbush and associated half-shrubs are winterfat, birdfoot sagebrush, and bud sagebrush. Some perennial grasses and forbs are common in this vegetation type. Bottlebrush squirreltail (*Sitanion hystrix*), western wheatgrass, Canby's bluegrass, and Indian ricegrass are common grasses. Common forbs are Hoods phlox and halogeton (*Halogeton glomeratus*).
>
> "In comparison to other saltbush areas, there was a wider variety of vegetation on the shale outcrop ridge. Gardner saltbush was less abundant here than in the two other saltbush areas. Species found on the shale ridge include rubber rabbitbrush, Douglas rabbitbrush, big sagebrush, and Hooker sandwort (*Arenaria hookeri*)."

Two dominant *Atriplex* species--*confertifolia* and the *nuttallii*/*gardneri* complex--were identified on Red Rim by both the BLM and others (1976) and RME (1982b) studies. Van Dersal (1939) described the *Atriplex* as monoecious or dioecious shrubs and in general as being of importance as forage for plains wildlife. Anderson (1980) described the *Atriplex* as being shrubs or subshrubs occurring where the land is high in soluble salts or alkalinity. Shadscale (*Atriplex confertifolia*), according to Van Dersal (1938), is "a small, spiny, rigid, dioecious thickly branched, dense, clump-forming shrub" found on alkaline soils to pH 8.0, which is of great importance as browse for sheep and, to some extent, cattle, although spines often interfere with browsing by cattle. Cronquist (1972) reported shadscale as being palatable, maintaining its nutritive value through the winter with the spines preventing more than 15 to 20 percent utilization of the previous summer total herbage growth. Branson (1966) found shadscale occupying sites having much lower osmotic stress at field capacity (2.2 atmospheres) than Nuttall's saltbush (*Atriplex nuttallii*) with 6.3 atmospheres. (See figure E-7.)

The Nuttall's or Gardner saltbush (*A. nuttallii* or *A. gardneri*) occupy the deeper, more alkaline soils of the petition area.

The *Atriplex gardneri* species is associated with greasewood because of their tolerance to soluble salts, sodium, and general site aridity. Tidestrom (1925) described the species as occurring on very different sites. The greasewood occupies sites having greater moisture availability than the Gardner saltbush, which were found generally occupying alkaline flats, badlands, or arid valleys (Rydberg, 1922). In addition, Tidestrom (1925) commented that the association of the two species indicates a soil that contains alkali in the second or third foot and in which ground water, when present, is limited to the deeper soil, therefore being unavailable to any great extent to Gardner saltbush but available at least during a part of the year to deeper rooted greasewood.



Osmotic stress caused by soil salts in 13 vegetation types in six western states. Sites sampled varied from 12 to one per type with a total of 58 sites sampled. Black bars indicate salt desert shrubs.

Figure E-7.--Plant communities and relative osmotic stress at field capacity. (Source: Modified from Branson, 1967.)

Rooting depths on the greasewood may reach 20 to 30 feet and it frequently occupies a position similar to that of a phreatophyte. The Gardner saltbush appears to be intolerant of flooding, whereas occasional or limited amounts of flooding is tolerated by the greasewood.

The Black Butte premine vegetation study identified two community types having significant amounts of Gardner saltbush, the greasewood and Gardner saltbush type described under Greasewood-Dominated Types, and the Atriplex nuttallii-Artemisia spinescens-Oryzopsis hymenoides-Poa secunda-Sitanion hystrix community type. Ecological Consulting Service (1975) described the latter type as usually being found adjacent to the greasewood type along creek bottoms and also in patches interspersed with areas of big sagebrush. No Gardner saltbush type was recognized by Mine Reclamation Consultants on the Arch Mineral Corporation's Seminoe No. 2 lease analysis. BLM's EMRIA study of the Hanna Basin coal field identified and described a Nuttall's saltbush community type and the quantitative data are given in table E-7.

C. BIG SAGEBRUSH-DOMINATED COMMUNITY TYPES

Beetle (1982) reported that 58,000 square miles, or nearly two-thirds of the State of Wyoming, is covered with some type of sagebrush (Artemisia sp.). Big sagebrush (Artemesia tridentata) is the most common shrub of western North America, covering approximately 226,400 square miles (Blaisdell, 1982). Blaisdell further described the big sagebrush complex as being "composed of aromatic, evergreen shrubs ranging in size from dwarf to tall, arborescent forms up to 15 feet (4.5 m) tall. The lower forms generally have several main stems arising from the base, whereas the tall forms often have a short single trunk." The genus Artemisia section tridentata is highly complex with seven species, five subspecies, and one form occurring in Wyoming. The big sagebrush (Artemisia tridentata) complex is composed of three subspecies and one form, according to Beetle (1960, 1965) and Beetle and Johnson (1982), as follows:

Artemisia tridentata ssp. tridentata

Artemisia tridentata ssp. wyomingensis

Artemisia tridentata ssp. vaseyana

Artemisia tridentata ssp. vaseyana f. spiciformis

The subspecies and/or forms are distinctly different in their autecology, distribution, and floristic characteristics. Refer to table II-10 from Beetle and Young (1965) for additional data. Their separation in the baseline inventory studies and revegetation planning activities for the Red Rim tract are of critical importance. Failure to make these taxonomic separations makes evaluation of the Red Rim vegetation very difficult.

The big sagebrush community types on the Red Rim tract occupy the higher terrace/lower portions of the alluvial fans, several of the alluvial fans, some of the broad U-shaped drainage basins between residual ridges, and the residual ridges/bedrock outcrops. In the southwestern portion of the area, the big sagebrush communities are also found on the tabular divides and rolling deep residual uplands.

Table E-7.--Percentage cover of vegetation, mulch, and bare soil for the Nuttall saltbush community types on the Hanna Basin coal field study site

(Source: Bureau of Land Management and others, 1975)

Genus and species	Common name	Percentage cover
Shrubs:		
Atriplex nuttallii	Nuttall saltbush	13.8
Grasses and grass-like:		
Poa secunda	Sandberg bluegrass	2.7
Mulch		5.5
Bare soil		78.0

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At least two of the big sagebrush subspecies, basin big sagebrush (Artemisia tridentata ssp. tridentata) and Wyoming big sagebrush (Artemisia tridentata ssp. wyomingensis) occur on the tract and were recognized or separated by RME on the riparian vegetation mapping unit. The big sagebrush subspecies occur on a wide range of soils and with many different codominants.

A complex of big sagebrush types has been recognized both on the tract and in the region. Both Branson (Bureau of Land Management and others, 1976) and RME (1982b) recognized big sagebrush and sage types, and the respective characterization data is found in tables E-8 and E-9. It is apparent that the two community types are quite different by cursory evaluation of the data. Height of the "big sage" identified by RME suggests that it might be Artemisia tridentata ssp. tridentata. The RME qualitative description of the community types follows:

> **Big Sagebrush**
>
> "The sage vegetation type occurs on loamy soils in or near drainage basins. The sage generally stands 1½-2 feet tall, but would be larger than 2 ft in drainages. The slope ranges from 0 to 11 percent, but occurs primarily between 2 and 7 percent.
>
> "Shrubs dominating this vegetation type are big sage and Douglas rabbitbrush (Chrysothamnus viscidiflorus). Snowberry (Symphoricarpos albus) is also found in association with these shrubs.
>
> "The understory consists of both perennial grasses and forbs, and annual forbs. Common grasses are western wheatgrass (Agropyron smithii), Canby bluegrass (Poa canbyi), and Fendler bluegrass (Poa fendleriana). Hoods phlox (Phlox hoodii) and bushy birdbeak (Cordylanthus ramosus) are the most common perennial and annual forb. Smaller, less conspicuous annual forbs such as littleflower collinsia (Collinsia parviflora), slenderleaf collomia (Collomia linearis), draba (Draba oligosperma), and groundsmoke (Gayophytum sp.) constitute part of the early spring understory cover.
>
> "Other species found in the sage vegetation type include the grasses squirreltail (Sitanion sp.), needle-and-thread (Stipa comata), and Indian ricegrass (Oryzopsis hymenoides). Among the common perennial forbs found are cushion buckwheat (Eriogonum ovalifolium), and silvery lupine (Lupinus argenteus)."

The Hanna Basin Coal Field Study (Bureau of Land Management and others, 1975) identified two big sagebrush community types--big sagebrush/Western wheatgrass and big sagebrush/shadscale. A third community type, the birdfoot sagebrush type contained significant amounts of big sagebrush. The quantitative data for characterization of the first two types are found in tables E-10 and E-11. The baseline inventory from the Arch Mineral Corporation's Seminoe No. 2 mine recognized the big sagebrush community type. The characterization data appear in table E-12 and provide a more detailed evaluation of the floristic characteristics of the community type than has been found elsewhere.

Table E-8.--*Cover and production data for the big sagebrush vegetative type from BLM's EMRIA site*

(Source: Bureau of Land Management and others, 1976)

	Percentage cover	Yield (lb/acre)
Artemisia tridentata	41.0	325.5
Atriplex nuttallii	----	7.5
Eurotia lanata	----	1.8
Gutierrezia sarothrae	0.7	54.2
Opuntia polyacantha	0.7	----
Agropyron dasystachyum	3.2	10.8
Agropyron smithii	2.7	27.2
Agropyron spicatum	1.0	----
Oryzopsis hymenoides	1.0	2.5
Poa secunda	1.3	0.8
Sitanion hystrix	4.2	17.0
Chenopodium album	----	3.0
Eriogonum sp.	0.3	2.5
Lappula sp.	----	0.5
Phlox hoodii	0.2	17.8
Sisymbrium sp.	----	6.0
Unidentified forbs	----	10.8
Live cover and total vegetation yield	56.3	487.9
Mulch	33.6	1,122.5
Bare	9.6	----
Rock	18.3	----

Table E-9.--Characterization of the sage vegetation type in the Red Rim, Wyoming, study area

(Source: Rocky Mountain Energy Company, 1982b)

Plant species	Mean shrub height (inches)	Line-intercept canopy cover (percent)	Line-intercept litter cover (percent)	Frequency among transects (percent)	Cover quadrats (percent)	Frequency by quadrats (percent)	Shrub density per acre	1980 production (lb/acre)
Shrubs:								
Artemisia tridentata	44.76	22.28	8.4	100.0	----	----	7,144	----
Amelanchier alnifolia	----	----	----	----	----	----	15	----
Chrysothamnus nauseosus	----	----	----	----	----	----	4	----
Chrysothamnus viscidiflorous	19.48	3.31	0.1	92.9	----	----	6,621	----
Grayia spinosa	34.9	0.6	----	7.1	----	----	15	----
Sarcobatus vermiculatus	103.3	0.17	----	3.6	----	----	29	----
Symphoricarpus albus	23.43	0.74	----	14.3	----	----	711	----
Tetradymia canescens	19.0	0.04	----	3.6	----	----	29	----
Totals	[1]40.81	27.14	8.5	----	----	----	14,549	----
Half-Shrubs:	----							
Atriplex gardneri	----	----	----	----	0.03	1.6	74	----
Ceratoides lanata	----	----	----	----	0.3	11.3	----	----
Leptodactylon pungens	----	----	----	----	0.3	9.7	----	----
Totals					0.63			
							Grass	157.2
							Forbs	81.3
							Total	238.5

[1] Mean.

Numbers of plots: Shrub canopy cover = 63; production = 97; shrub density = 54.

Table E-10.--Percentage cover of vegetation, mulch, and bare soil for the big sagebrush-Western wheatgrass community type on the Hanna Basin coal field study site

(Source: Bureau of Land Management and others, 1975)

Genus and species	Common name	Percentage cover
Shrubs:		
Artemisia pedatifida	Bird sagebrush	0.5
Artemisia tridentata	Big sagebrush	13.0
Grasses and grass-like:		
Agropyron smithii	Western wheatgrass	22.5
Agropyron spicatum	Bluebunch wheatgrass	2.5
Carex eleocharis	Needleleaf sedge	1.5
Poa secunda	Sandberg bluegrass	6.7
Stipa comata	Needle-and-thread	1.2
Forbs:		
Antennaria aprica	Pussytoes	0.2
Phlox longifolia	Longleaf phlox	1.2
Mulch		28.0
Bare soil		23.0

Table E-11.--Percentage cover of vegetation, mulch, rock, and bare soil for the big sagebrush-shadscale community type on the Hanna Basin coal field study site

(Source: Bureau of Land Management and others, 1975)

Genus and species	Common name	Percentage cover
Shrubs:		
Artemisia spinescens	Bud sagebrush	1.5
Artemisia tridentata	Big sagebrush	3.2
Atriplex confertifolia	Shadscale	5.8
Chrysothamnus greenei	Greenes rabbitbrush	0.7
Gutierrezia sarothrae	Snakeweed	0.7
Opuntia polyacantha	Plains pricklypear	0.2
Tetradymia spinosa	Spiny horsebrush	1.2
Grasses and grass-like:		
Agropyron smithii	Western wheatgrass	24.0
Poa secunda	Sandberg bluegrass	3.5
Sitanion hystrix	Squirreltail	1.2
Forbs:		
Phlox longifolia	Longleaf phlox	1.5
Mulch		18.0
Rock		5.0
Bare soil		28.5

Table E-12.--Arch Mineral Corporation's Seminoe No. 2 mine cover and yield data for the big sagebrush community type

(Source: Mine Reclamation Consultants, 1977)

Cover data	
Perennials	Average (percent)
Grasses:	
Agropyron dasystachyum (Hook.) Scr	1.21
Agropyron smithii Rydb.	.81
Agrophron spicatum (Pursh) Scribn.	2.15
Bouteloua gracilis (H.B.K.) Lag.	.02
Hordeum brachyantherum Nevski	----
Koeleria cristata (L.) Pers.	(tr)
Oryzopsis hymenoides (Roem.) Schu	.38
Poa fendleriana (Steud.) Vasey	.10
Poa secunda Presl	.97
Sitanion hystrix (Nutt.) J. G. Smi	.04
Stipa comata Trin. and Rupr.	.06
Stipa viridula Trin.	.01
Total	5.57
Grasslike:	
Carex eleocharis Bailey	0.03
Carex filifolia Nutt.	.48
Total	0.51
Forbs:	
Agoseris glauca (Pursh) D. Dietr	(tr)
Allium textile A. Nels. and MacBr.	----
Antennaria rosea Greene	0.01
Arenaria hookeri Nutt.	.09
Artemisia ludoviciana Nutt.	(tr)
Arenaria spp. L.	.29
Astragalus spp. L.	.38
Calochortus nuttallii T. and G.	(tr)
Erigeron pumilus Nutt.	.03
Erigeron spp. L.	.05
Haplopappus acaulis (Nutt.) Gray	.37
Lappula redowskii (Hornem.) Greene	.01
Leptodactylon pungens (Torr.) Rydb	.07
Machaeranthera glabriuscula (Nutt.)	.10
Other	.03
Penstemon spp. Mitchell	.03
Phlox hoodii Richards.	1.04
Sphaeralcea coccinea (Pursh) Rydb.	(tr)
Trifolium spp. L.	(tr)
Vicia americana Muh.	.03
Total	2.52

Table E-12.--Arch Mineral Corporation's Seminoe No. 2 mine cover and yield data for the big sagebrush community type--Continued

Cover data--Continued	
Perennials	Average (percent)
Half shrubs:	
Artemisia frigida Willd.	0.02
Artemisia pedatifida Nutt.	.09
Atriplex Nuttallii Wats. (*Atriplex*)	.09
Ceratoides lanata (Pursh) J. T. Ho	.12
Xanthocephalum sarathrae (Pursh) S	.13
Total	0.45
Shrubs:	
Artemisia tridentata Nutt. var. *tr*	12.62
Atriplex confertifolia (Torr. and	.47
Chrysothamnus nauseosus (Pallus) B	.04
Chrysothamnus viscidiflorus (Hook.)	.63
Grayia spinosa (Hook.) Moq.	.10
Sarcobatus vermiculatus (Hook.) Em	.03
Tetradymia canescens Oc.	.05
Total	13.98
Succulents:	
Opuntia polyacantha Haw.	0.05
Total	0.05
Total perennials	23.28
Annuals	Average (percent)
Annual grasses:	
Bromus tectorum L.	0.01
Total	0.01
Annual forbs:	
Miscellaneous	0.01
Salsola kali L.	(tr)
Total	0.01
Total annuals	0.02

Table E-12.--Arch Mineral Corporation's Seminoe No. 2 mine cover and yield data for the big sagebrush community type--Continued

Cover data--Continued

Xanthoparmelia	Average (percent)
Xanthoparmelia chlorochroa (Tuck.)	0.11
Total *Xanthoparmelia*	0.11
Grand total	23.41

Other	Average (percent)
Rocks	5.38
Litter	30.39
Bare ground	41.51
Vegetation	22.72
Total other	100.00

Yield data

Perennials	Average (pounds per acre)
Grasses:	
Agropyron dasytachyum (Hook.) Scr	19.11
Other	6.91
Poa secunda Presl	1.57
Sitanion hystrix (Nutt.) J. G. Smi	.37
Total	27.96
Forbs:	
Erigeron pumilus (Nutt.)	0.21
Other	.42
Total	0.64
Half shrubs:	
Atriplex nuttallii Wats. (*Atriplex*)	4.94
Total	4.94

Table E-12.--Arch Mineral Corporation's Seminoe No. 2 mine cover and yield data for the big sagebrush community type--Continued

Yield data--Continued	
Perennials	Average (pounds per acre)
Shrubs:	
Artemisia tridentata Nutt. var. *tr*	75.00
Atriplex confertifolia Torr. and	1.74
Chrysothamnus viscidiflorus (Hook.)	1.30
Other	.86
Sarcobatus vermiculatus (Hook.) Em	2.39
Total	81.79
Total perennials	114.81
Grand total	114.81

Branson (Bureau of Land Management and others, 1976), during the EMRIA study, identified a big sagebrush and Western wheatgrass community type. Supporting data suggest that the separation was made on the production of Western wheatgrass and somewhat more depauperate flora. The characterization data for this community type is found in table E-13. RME recognized a sage-grass vegetative type for which the quantitative data are found in table E-14. The primary separation point seems to be the much richer shrub flora in the sage-grass mapping unit than in the sage unit. Additionally, the sage-grass mapping unit is described on shallow soils (less than 20 inches over bedrock), whereas the sage mapping unit was described as occupying drainage basins where the soils would presumably be deep (greater than 60 inches). The RME qualitative description of the sage-grass type follows:

Sage-Grass

> "The sage-grass vegetation type is spread throughout the entire study area. Sagebrush-grass occurs on gentle to medium slopes that range from 0 to 20 percent, but most often occur between 2 and 9 percent. The soil is a shallow loam, often slightly gravelly.
>
> "The dominant shrub in this vegetation type is big sagebrush. Subdominate shrub species are gray horsebrush (Tetradymia canescens), Douglas rabbitbrush, and spiny hopsage (Grayia spinosa).
>
> "The understory consists of perennial grasses, forbs, and annual forbs. Bluegrass, Indian ricegrass, needleandthread, and western wheatgrass are the common grass species. Typical forbs found in the sage-grass understory include hoary aster (Machaeranthera canescens), aster (Aster chilensis), and beard tongue (Penstemon spp.). Bushy birdbeak, textile onion (Allium textile), and hollyleaf clover (Trifolium gymnocarpon) are common annual forbs. Common perennial mat formers are Hoods phlox, stemless goldenweed, (Stenotus acaulis), tufted milkvetch (Astragalus spatulatus), and Pursh locoweed (Astragalus purshii). Winterfat is the most common half-shrub in the sage-grass vegetation type.
>
> "Other associated species are rubber rabbitbrush (Chrysothamnus nauseosus), cottonthorn horsebrush (Tetradymia spinosa), shadscale saltbush (Atriplex confertifolia), and Antelope bitterbrush (Purshia tridentata). Associated half-shrub species are Gardner saltbush (Atriplex gardneri), birdfoot sage (Artemisia pedatifida), and bud sage (A. spinescens)."

RME recognized a riparian mapping unit which contains a large amount of big sagebrush--primarily basin big sagebrush. The riparian unit was not recognized in the BLM's EMRIA study. The quantitative data characterizing the community is presented in table E-15. The qualitative description for the riparian unit is as follows:

Riparian Vegetation

> "The riparian vegetation type is found on a narrow strip of land along Separation Creek. It varies in width from several feet wide

Table E-13.--Cover and production data for the big sagebrush and western wheatgrass vegetative types from BLM's EMRIA site

(Source: Bureau of Land Management and others, 1976)

	Percentage cover	Yield (lb/acre)
Artemisia tridentata	39.6	208.0
Atriplex nuttallii	1.7	----
Grayia spinosa	7.0	----
Agropyron smithii	2.0	102.0
Sitanion hystrix	6.3	3.5
Poa secunda	0.7	1.0
Cerastium sp.	----	0.5
Mimulus sp.	----	45.5
Lappula sp.	----	1.5
Sisymbrium sp.	0.3	4.5
Live cover and total vegetation yield	57.6	366.5
Mulch	26.7	2,064.5
Bare	13.7	----
Rock	2.0	----

Table E-14.--Characterization of the sage-grass vegetation type in the Red Rim, Wyoming, study area

(Source: Rocky Mountain Energy Company, 1982b)

Plant species	Mean shrub height (inches)	Line-intercept canopy cover (percent)	Line-intercept litter cover (percent)	Frequency among transects (percent)	Cover quadrats (percent)	Frequency by quadrats (percent)	Shrub density per acre	1980 production (lb/acre)
Shrubs:								
Artemisia nova	12.16	0.30	0.1	8.6	----	----	261	----
Artemisia tridentata	21.75	7.82	4.0	96.6	----	----	3,383	----
Atriplex confertifolia	19.78	0.13	----	8.6	----	----	116	----
Atriplex gardneri	4.77	0.27	----	24.1	----	----	1,568	----
Chrysothamnus nauseosus	25.38	0.11	----	12.1	----	----	73	----
Chrysothamnus viscidiflorus	14.03	1.23	0.3	62.1	----	----	2,425	----
Grayia spinosa	34.83	0.56	----	12.1	----	----	305	----
Purshia tridentata	24.50	0.29	----	3.4	----	----	102	----
Sarcobatus vermiculatus	34.85	0.08	----	3.4	----	----	58	----
Symphoricarpus albus	15.0	0.01	----	1.7	----	----	15	----
Tetradymia canescens	13.16	0.38	0.1	29.3	----	----	319	----
Tetradymia spinosa	19.33	0.02	----	5.2	----	----	15	----
Totals	[1]19.96	11.2	4.5	----			8,640	
Half-Shrubs:								
Artemisia pedatifida	----	----	----	----	0.2	11.1	----	----
Artemisia spinescens	----	----	----	----	0.2	3.7	----	----
Atriplex gardneri	----	----	----	----	0.9	14.8	----	----
Ceratoides lanata	----	----	----	----	1.0	29.6	----	----
Leptodactylon pungens	----	----	----	----	0.3	7.4	----	----
Totals					2.6			
							Grass	176.8
							Forbs	25.0
							Total	201.8

---

[1] Mean.

Numbers of plots: Shrub canopy cover = 58; production = 27; shrub density = 40.

Table E-15.--Characterization of the riparian vegetation type in the Red Rim, Wyoming, study area

(Source: Rocky Mountain Energy Company, 1982b)

Plant species	Mean shrub height (inches)	Line-intercept canopy cover (percent)	Line-intercept litter cover (percent)	Frequency among transects (percent)	Cover quadrats (percent)	Frequency by quadrats (percent)	Shrub density per acre	1980 production (lb/acre)
Shrubs:								
Artemisia cana	35.96	0.15	----	13.8	----	----	73	----
Artemisia tridentata	82.32	8.94	4.1	85.3	----	----	[2]2,875	----
Atriplex gardneri	7.8	TR	----	0.92	----	----	4	----
Chrysothamnus nauseosus	31.75	0.08	----	7.3	----	----	58	
Chrysothamnus viscidiflorus	22.71	0.26	----	11.9	----	----	465	----
Ribes aureum	67.43	0.08	----	2.8	----	----	29	----
Rosa woodsii	39.82	2.64	0.1	68.8	----	----	3,180	----
Salix sp.	115.66	3.42	1.8	43.1	----	----	1,133	
Sarcobatus vermiculatus	72.55	0.17	----	13.8	----	----	116	----
Symphoricarpos albus	37.4	0.04	----	0.92	----	----	44	----
Totals	[1]51.34	----	----	----			7,977	----
Half-Shrubs:	----							
Artemisia ludoviciana	----	----	----	----	0.3	13.6	----	----
Totals					0.3	13.6		
							Grass	1,032.3
							Forbs	525.1
							Total	1,557.4

---

[1] Mean.

[2] Artemisia tridentata ssp. tridentata = 2,860; Artemisia tridentata ssp. wyomingensis = 15.

Numbers of plots: Shrub canopy cover = 109; production = 88; shrub density = 78.

along the steeper drainage ways to several hundred feet wide along other portions of the creek. The soil is a finely textured, moderately level (0-5 percent); however, along the creek banks the slopes may be as steep as 80 percent.

"In the riparian vegetation type, the plant cover varies depending upon the creekbed topography. More shrubs are present where the creek banks are steep. Where the banks are shallow, rushes, sedges, and grasses dominate the vegetative cover.

"The dominant shrub within this vegetation type is big sage (*A. tridentata* ssp. *tridentata*). Subdominant shrub species are willow (*Salix* spp.) and Woods rose (*Rosa woodsii*).

"The understory consists of a variety of perennial forbs and grasses. The common forbs are poverty sumpweed (*Iva axillaris*), thistle (*Cirsium* sp.), aster (*A. chilensis*), western yarrow (*Achillea lanulosa*), field mint (*Mentha arvensis*), and dock (*Rumex cinereus*), quackgrass (*Agropyron repens*), bluegrass, foxtail barley (*Hordeum jubatum*), and bentgrass (*Agrostis gigantea*). The rush *Juncus arcticus* is also a common understory species in the riparian vegetation type.

APPENDIX F

POTENTIAL RECLAMATION OPTIONS FOR THE RED RIM TRACT

POTENTIAL RECLAMATION OPTIONS FOR THE RED RIM TRACT

By Scott E. Fisher, Jr.

Appendix F has been constructed to provide as much detail as possible concerning each of the potential reclamation options for the Red Rim tract. The description of each scenario contains the assumptions upon which the potential for success, reclamation goals/directions, and required resource and technical inputs are set forth. Also presented are the cost estimates for the specific baseline and related studies and reclamation as defined in each of the scenarios. In addition, the discussion of the options include OSM's best professional estimate of what research and baseline studies would be required, if the Federal coal underlying the Red Rim petition area were leased for mining and reclamation (conducted as defined in each of the scenarios). Note that the estimates and baseline/planning requirements are based on professional judgments and would necessarily be modified as additional site specific data becomes available.

The development of the three reclamation scenarios for reclaiming the Red Rim site was undertaken by OSM as a means for analyzing the petition allegations. Because a primary concern of the petition is reclamation of the mined critical winter range to meet the requirements of the wintering pronghorn, reclamation scenario 1 was developed to meet these goals. As previously stated throughout the revegetation and related portions of this document, many of the reclamation methods and concepts that were utilized have not been fully tested in an integrated manner on any large scale effort. The reclamation called for under this reclamation scenario would be that which would, in OSM's estimation, be required to achieve the postmining land use goal of reclamation scenario 1, that of accomplishing, as much as possible, the restoration of the pronghorn critical winter range and production of livestock forage in disturbance areas. Many of these reclamation practices are not currently required by regulation, as they exceed the minimum performance standards of Wyoming's approved State program and Wyoming DEQ's regulations and guidelines. However, depending upon the importance OSM and Wyoming DEQ place on recreating that portion of the pronghorn critical winter range affected by mining, such reclamation could be required of the mining company as a condition of OSM/Wyoming DEQ's approval of a mining and reclamation plan on Red Rim.

Reclamation scenario 3 was developed to reflect the current reclamation practices which are being utilized on a large number of mines in Wyoming. Reclamation under this scenario should meet the current minimum reclamation standards of Wyoming's approved State program and Wyoming DEQ regulations and guidelines. Reclamation scenario 2 recognizes the Federal-private checkerboard land ownership pattern of the area and the differences in reclamation requirements which could occur as the result of different decisions on the petition by the Secretary of the Interior and Wyoming EQC, respectively, on Federal and private lands. These different decisions are not discussed per se in this appendix because, in essence, they would involve reclamation in accordance with reclamation scenario 1 and reclamation scenario 3 on alternating sections of land in the petition area.

With reclamation scenario 1, the revegetation effort would make maximum use of the best available technology at the time of reclamation to develop shrub communities which would meet the critical winter range requirements of the pronghorn and, secondarily, produce livestock forage. An equally important revegetation goal would be the requirement of establishing plant communities which would be capable of assisting in the stabilization of the reclaimed landscape. A major effort would have to be undertaken to reconstruct the topography of the site to meet the requirements for snow redistribution, forage availability and production, and protection for the pronghorn during severe storms. If these components, and the rest of the reclamation effort, are successful, mitigation of most of the impacts to pronghorn using the reclaimed portion of the winter range should be accomplished. Under reclamation scenario 3, the revegetation effort would attempt to develop plant communities and a topographic configuration which would have greater emphasis on production of livestock forage while meeting a limited number of the requirements for pronghorn. Reclamation scenario 1 stresses full application of technology and research to mitigate impact on pronghorn while restoring most of the livestock carrying capacity. Table F-1 (located at the end of this appendix) compares and analyzes reclamation scenarios 1 and 3.

Under any reclamation scenario, the reclaimed plant communities would have to accomplish a portion of the following:

1. Contribute to the stabilization of the reclaimed landscape, including the relatively long steep gradient slopes which would probably have limited infiltration and percolation capacities.

2. Minesoils constructed on the site would have to have characteristics suited to the plant species composing a plant community and, if such soils could not be constructed, then plant species adapted to the minesoil characteristics would have to be utilized. Additionally, the plant species included in development of the reclaimed plant communities would have to be adapted to the harsh climatic regime of the area. With the stated requirement for collection of plant materials from the site under reclamation scenario 1, the climatic adaptation issue should be met.

3. A sufficiently large number of plant communities would have to be reconstructed to meet the requirements for multiple-use land management, specifically by making adequate amounts of forage available for both livestock and pronghorn.

4. Produce forage that would meet the requirements of the pronghorn, particularly their need for a palatable forage which is high in both protein content and caloric content in readily digestible forms.

5. Plant communities and species having a similar life form and structure to the existing vegetation to allow snow removal by wind.

Reclamation Scenario 1

Objective.--Reclamation of the Red Rim tract to restore the pronghorn critical winter range, including producing a plant community (composition, lifeform, and distribution) and topography that would function as similar as possible to the premining habitat.

This reclamation scenario sets the conditions for development and evaluation of the potential for reestablishment of plant communities and topography similar to the premining environment in its capacity to meet the pronghorn needs. The data above and, more importantly, the existing vegetative resource data presented in appendix E document the shrub dominance of the existing plant communities. Reclamation under this scenario would not attempt to reconstruct the very high densities of shrubs currently found on the site. Instead, the goal would be to establish a variety of shrub species and shrub dominated communities adequate to meet reclamation/revegetation goals. Concentration on reestablishment of big sagebrush, particularly Artemisia tridentata ssp. wyomingensis, appears to be essential to this effort, although the inclusion of other shrub species could be very important.

The RME data on big sagebrush presented in appendix E may not be reliable. Experience suggests that the densities RME found for basin and Wyoming big sagebrush (subspecies of big sagebrush) are high, but densities for a community type may vary widely within a given mapping unit. Given these limitations to data accuracy, RME data for all big sagebrush subspecies on Red Rim, by vegetative type, are:

(Data are in plants per acre)

Vegetative types	Big sagebrush density	Total shrubs
Greasewood	2,076	12,163
Mountain shrub	1,624	7,983
Riparian	2,875	7,977
Sage	7,144	14,549
Sage-grass	3,383	8,640
Saltbush	290	16,266

It may be possible to reduce shrub premining densities by producing individual plants having greater vigor and absolute cover values. The viability of this option cannot be finally assessed until the required research efforts are completed. The larger individual plants, if they could be produced and sustained, could increase the surface roughness sufficiently to accumulate more snow resulting in their exclusion from the available pronghorn forage base during critical periods.

OSM acknowledges that it would not be possible to reconstruct the existing plant communities. The primary revegetation objective would include development of plant communities which would meet the pronghorn habitat requirements, stabilize the reclaimed landscape, produce forage for livestock, provide a permanent vegetative cover for the disturbed landscape, and have sufficient diversity to meet land management and biological requirements. The revegetation goals for the community types being dominated by big sagebrush would be approximately 3,500 sagebrush plants per acre, as compared to 7,144 in the existing vegetative type. Several considerations are involved:

1. Reliability of the existing vegetation baseline data. Practical experience suggests that densities indicated could be high and, secondly, not uniform within the individual community type. The latter needs redefinition and separation.

2. On steeper slopes in a reclaimed landscape, it may not be possible to establish and develop shrub populations greater than 3,500.

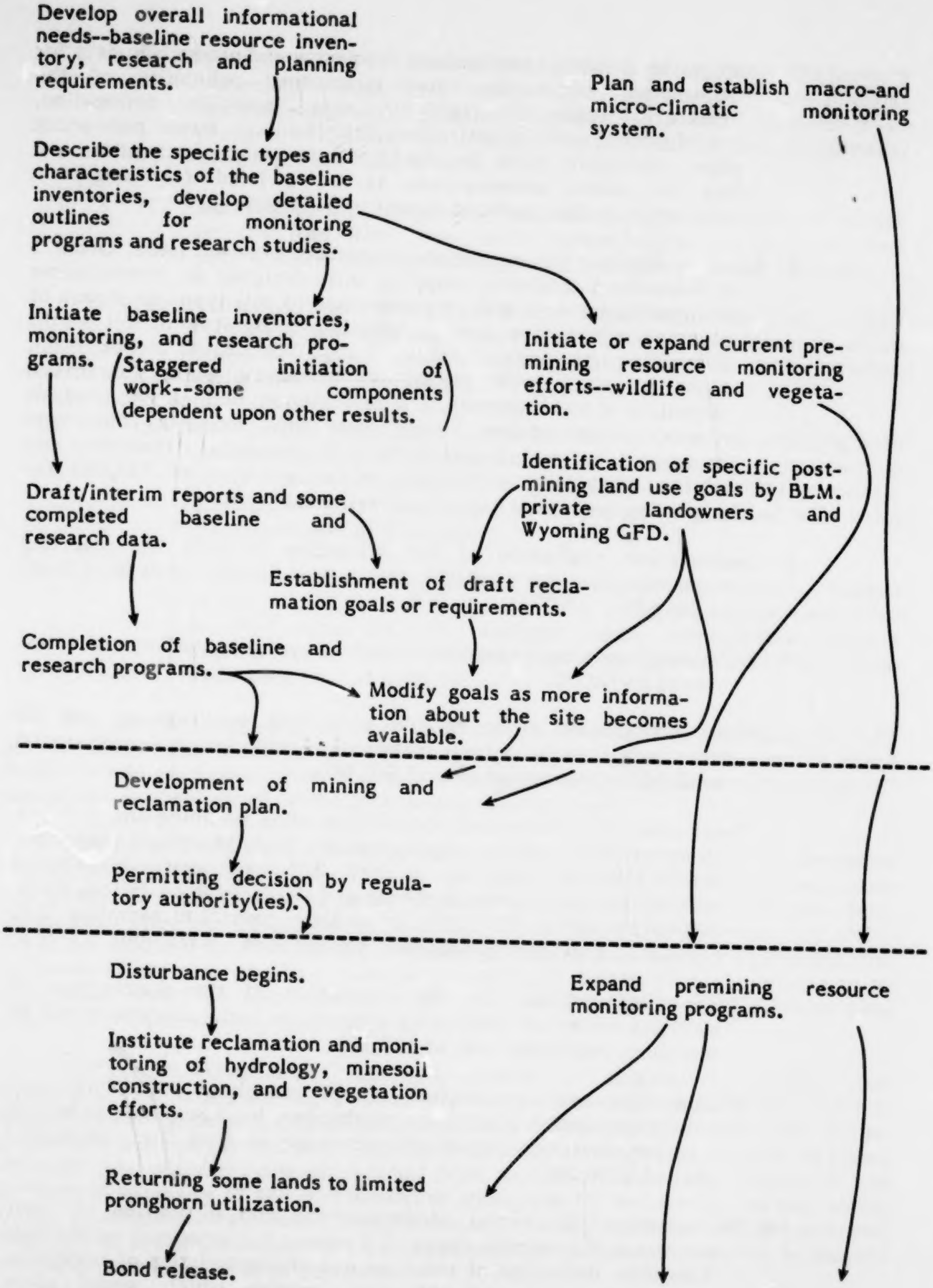
3. Density should be sufficiently high to produce adequate competition between individuals to limit overall size/vigor if this factor is not genetically determined.

Rethinking and modification of several of the steps currently utilized in reclamation and revegetation planning would be required to accomplish the objectives/goals identified with this scenario. Figure F-1 identifies the primary components and their appropriate sequence in the planning and reclamation process.

The first effort(s) would have to be the identification of information and data needs in the reclamation planning and mitigation efforts. Specific details would have to be identified--intensities, methods, parameters, statistics to be applied to the data--as well as overall development of specific inventory monitoring research projects. A number of studies and procedures have been proposed and "costed out" in the reclamation cost analysis. The information generated, its sequential availability and integration into a planning effort were a part of the assumptions made during the development of this scenario. Simultaneously, a detailed climatological monitoring system would have to be designed and installed. The length of time that it is operational would be critical to the appropriate utilization/application of such data in resolution of issues on Red Rim so it would have to be installed as soon as possible.

The first step in implementing reclamation scenario 1 would be to undertake the baseline studies (geology, overburden, soil, vegetation, along with the continuation of the wildlife work) and initiate the research efforts. Figure F-1 provides the general scheduling in which these efforts should be undertaken. The design and sequencing of these efforts would be critical to accomplishing the reclamation goals of reclamation scenario 1. The intensity of these studies far exceeds that normally required by Wyoming DEQ and Federal guidelines and regulations. (Note, however, that Wyoming's regulations allow Wyoming DEQ to require additional information or data when it is deemed necessary.) Some of the inventories and studies are described below, as well as the 1985 estimated costs for these efforts. These costs have been incorporated into the reclamation cost estimates in table IV-7.

1. A detailed premining vegetation inventory: inventory based on objective development of plant community classificational system, recognition and mapping of community gradients (coenclines) where mappable, establishment of statistically



Develop overall informational needs--baseline resource inventory, research and planning requirements.

Plan and establish macro-and micro-climatic monitoring system.

Describe the specific types and characteristics of the baseline inventories, develop detailed outlines for monitoring programs and research studies.

Initiate baseline inventories, monitoring, and research programs. (Staggered initiation of work--some components dependent upon other results.)

Initiate or expand current premining resource monitoring efforts--wildlife and vegetation.

Identification of specific post-mining land use goals by BLM. private landowners and Wyoming GFD.

Draft/interim reports and some completed baseline and research data.

Establishment of draft reclamation goals or requirements.

Completion of baseline and research programs.

Modify goals as more information about the site becomes available.

Development of mining and reclamation plan.

Permitting decision by regulatory authority(ies).

Disturbance begins.

Expand premining resource monitoring programs.

Institute reclamation and monitoring of hydrology, minesoil construction, and revegetation efforts.

Returning some lands to limited pronghorn utilization.

Bond release.

Figure F-1.--Sequence of activities needed to successfully implement reclamation scenario 1.

adequate absolute cover values, frequency and production data for each plant community type, guaranteed reliability of the inventory, scale of 1:400, 1 acre minimum delineation, establishment and quantitative definition of three permanent plant community sites for the dominant plant communities and two for minor communities to be utilized for long-term monitoring studies, estimated cost of $175,000.

2. Baseline detailed soil survey and inventory, scale of 1:400, Order 1 or Suborder 1 intensity, mapping units designed as consociations with particular emphasis on recognition of soil types or phases of importance to native plant distribution, recognition of soil depths as mapping unit design criteria (0-10, 10-20, 20-30 inches, etc.), major interface with vegetation inventory work, guaranteed reliability of the inventory, 1 acre minimum delineation, analysis of three representative pedons from each series or phase/type recognized, estimated cost of $160,000 for survey inventory and related description activities, estimated cost of $50,000 for supporting analytical and characterization work.

3. Quantitative evaluation of the reliability of both the soil and vegetation inventories, estimated cost of $20,000 each for a total of $40,000.

4. Premining topographic evaluation and geomorphic studies, estimated cost of $100,000.

5. Snow distribution study in the premining environment and its relationship to pronghorn distribution and forage location and availability, estimated cost of $60,000.

6. Overburden evaluations and suitability studies assuming one core per 40 acres except where major problems were identified then more detailed studies could be required, 250 cores approximately, 15 samples per core, estimated cost of $190,000 for analytical work, estimated cost of $375,000 for drilling cores and sampling (250 cores x 60 feet, average depth x $25 per foot = $375,000).

7. Geobotanical studies for the evaluation of the distribution of surficial materials containing potentially toxic concentrations of selenium, estimated cost of $35,000.

8. Continuation and acceleration of the pronghorn studies on food habits, population structure and changes, herd response to severe weather, and distribution of pronghorn on Red Rim, estimated cost of $200,000.

9. Development of several strategies for and evaluation of their success in the establishment of Wyoming big sagebrush on the Red Rim site, definition of the type and characteristics of minesoils, landforms and associated plant species which would allow reestablishment of the critical winter range habitat, estimated cost of $150,000.

10. Detailed study of the subspecies of big sagebrush (Artemesia tridentata) and their taxonomic relationships, autecological associations, amplitude, and requirements and relationship to pronghorn habitat, particularly the critical winter component, estimated cost of $100,000.

11. Reserach on the composition and distribution of the shrub species on the Red Rim area, their autecological requirements and potential for their reestablishment, estimated cost of $75,000.

12. Evaluation of erosion-sediment yield-stability of steep reconstructed landscapes and minesoils and the measure which could be implemented to enhance stability of such systems, estimated cost of $150,000.

13. Development of options for construction of minesoils utilizing both the premining soil information and overburden data, construction of such and evaluation of their stability and capacity to sustain the desired postmining plant communities on the Red Rim area, estimated cost of $125,000.

14. Institution of studies of successionary change on minesoils, changes in both plant and soil factors, on the shrub reestablishment sites on Red Rim, and on surface mining revegetation efforts approximating the environmental conditions on Red Rim, estimated cost of $100,000.

The approximate total cost of these studies would be $2,085,000, or $173.75 per disturbed acre based on a mine disturbing 12,000 acres. The cost of these studies would amount to approximately 3 cents per ton of the 69.0 million tons of coal that would be mined on the proposed coal lease tract.

The above studies and baseline efforts do not represent the only requirements needed at this stage of development of the potential lease. The estimated costs are based on a rough cost analysis of study designs which have not been fully developed. They are included only as a guide to the financial commitments which would be required to develop this proposed lease tract. The work outlined is the minimum effort that would be necessary; additional studies that would have to be undertaken would be identified as work progressed on the baseline inventories, research, and reclamation planning.

Overburden.--Overburden sampling should be sufficiently intense that mapping of the strata having a relatively narrow range of physical or chemical properties can be accomplished (Dollhopf, 1983; Abbott, 1982). Stratified testing procedures are not particularly applicable to general treatment of such samples, although they might provide some relief from routine analysis. The reasons for the increase in intensity of the overburden sampling are (1) to identify pyritic, toxic, saline, or alkaline strata, and (2) to isolate strata which could be utilized with soil materials to provide adequate soil depths of suitable composition needed to support the plant communities to be established.

Selective handling of overburden materials would probably be necessary to accomplish the revegetation goals outlined in this reclamation scenario and to deal with potentially acid or toxic-forming materials. This type of overburden handling would be much more difficult to accomplish in a dragline operation than under a truck-and-shovel operation. Parameters of critical importance would include exchangeable sodium percentage (ESP), electrical conductivity, pH, texture, acid-base account, available water-holding capacity, and sulfur analysis, including pyrite, sulfate-sulfur, organic sulfur, and calcium carbonate percentage.

The overburden materials would be a very important part of the minesoils constructed on the Red Rim, as such materials would make up a major portion of the minesoil--particularly the rooting zone of many shrub species. A major emphasis of the overburden work would be the acquisition of sufficient data to construct predictive models of spoil materials important in the construction of the lower minesoil strata. Such an effort would be essential and would have to be fully integrated with the results from research and taxonomy/ecological amplitudes of the various big sagebrush subspecies. Potentially serious acid-forming material problems are indicated in the EMRIA Red Rim Report (Bureau of Land Management, 1976).

pH values for an overburden core from the Red Rim area

Site No.	Depth (feet)	pH (1:5 H_2O)	pH (OIM $CaCl_2$)
RR-6-4	5.0 to 7.5	4.7	4.4
RR-6-5	12.5 to 17.0	--	3.8
RR-6-6	17.0 to 21.5	3.8	3.7
RR-6-7	21.5 to 24.5	4.0	3.9
RR-6-8	25.0 to 28.4	3.3	3.3
RR-6-9	28.4 to 32.0	5.4	5.1

Minesoils pH values less than 4.8 (Askenasy, 1984) or 4.5 (Fisher and Munshower, 1984) are the result of oxidation of acid-forming materials.

Plant species occurrence and distribution on the site, as well as general knowledge of the area, would suggest that a careful review of the presence of selenium in premining vegetation and soils, as well as overburden, would also be necessary. Resolution of these potential problems could dramatically influence the cost of mining and reclamation on the Red Rim property.

Soils.--Very detailed soil resource inventory, analysis, and evaluation are critical to successful reclamation of the Red Rim tract to the standards set forth in this scenario. Requirements for the soil inventory follow the definition found in the outline of studies and research. Testing procedures based on sample stratification could be utilized, provided they were well designed and met the specific needs of the revegetation effort (an edaphic, rather than pedologic, emphasis). The 10-percent duplicate sampling and analysis program outlined in the soil criteria above would have to be adhered to strictly, as the resulting data could well define the success or failure of the revegetation effort (Sandoval, 1979; Severson and Fisher, 1985). Quantitative evaluation of the statistical reliability of the inventory map should be made by an independent organization or agency, and the reliability should be 90 percent or greater at the mapping-unit level. Acceptable statistical procedures are available for such analyses.

Analysis of the very limited amount of available soil information indicates that materials for development of minesoils ideally suited to supporting big sagebrush would be limited on the tract. At this point, for example, it is not possible to turn to any overburden data and determine whether any of the strata could be successfully utilized in developing materials for the subsoil of the big sagebrush type. Such evaluations would be accomplished utilizing the amplitudes of the soil tolerance and suitability developed earlier for the dominant species in the community type that was being revegetated. The overburden drilling effort and mapping of the chemical and physical properties of the various strata could be applied to selective removal of materials for use in development of the minesoils.

To have any hope of successfully establishing the various sagebrush and mountain shrub types on this tract would require careful statistical selection and salvaging of soil materials. The topsoil and subsoil materials on the site which meet the criteria established for the basin and Wyoming big sagebrush subspecies then would have to be selectively removed during the topsoil removal operation and stored separately from other materials. This practice is considered necessary because recognized experts in revegetation suggest that the lack of mycorrhizal development with sagebrush subspecies is a major part of the reason for failure of seeded stands. At least one company is currently marketing an inoculum thought to enhance shrub establishment. The mycorrhizal-producing microorganisms are most prevalent in soil A horizons. With the goal in reclamation scenario 1 of meeting as many of the requirements for establishing big sagebrush as possible, it is deemed necessary to separate the surface horizons from the lower horizons and parent rock materials to prevent dilution and/or total loss of potential mycorrhizal development by change in the soil environment. Soil salvage operations would be based on stakes set minimally on 75-foot centers which had been marked with cut depths for both the topsoil and subsoil recovery. Within the ridge and valley terrain, the interval would probably have to be reduced to perhaps 25 feet to allow full recovery of soils currently supporting basin big sagebrush. Monitoring of soil removal, on the basis of the soil inventory information, and leaving islands for evaluation would have to be done throughout this operation. On the basis of both the complete literature search and the analysis of field studies, the potential need for separation of the saltbush-shadscale type and the greasewood soil materials would have to be made. Reestablishment requirements for the mountain shrub communities are thought to be quite different from those for the big sagebrush types in that they could require not only the topographic restoration but the large boulder-sized particles in association with good-quality soil materials--perhaps similar to Stark's (1982) suggestion for ponderosa pine revegetation.

Direct hauling of topsoil appears to have great potential in assisting in shrub reestablishment (Joe Coenenberg, Western Energy Company, Colstrip, Montana, oral communication, 1983; Tom Guobis, Native Plants, Inc., Salt Lake City, Utah, oral communication, 1983). Unfortunately, much of the support for this practice comes from observations rather than quantified data collected under controlled conditions. Success of the method seems to have a logical basis since direct transport of plant propagules and soil to serve as a mycorrhizal inoculum would serve to greatly enhance shrub reestablishment potential. Mycorrhizal studies have been limited in scope, but most professionals in the field have little doubt that they are of real importance in establishment of many shrub species (Frank Munshower, Reclamation Research, Montana State University, Bozeman, Montana, oral communication, 1983). Therefore, direct hauling would be required for all soil materials being used in the reestablishment of the big sagebrush communities. Direct hauling of topsoil requires a sophisticated level of mining and reclamation planning which must fully consider differences in site conditions, as it is difficult to fully achieve in some areas. The material from the first topsoil removal operation(s) would have to be stored until the pit has been closed. After the initial cut had been backfilled and graded to final contour, then the topsoil being actively salvaged could be direct hauled to the area. Such activities have been and are being carried out on existing mining operations in the Western United States.

The soil material identified for use in the big sagebrush or mountain shrub reestablishment program would have to be handled in the same manner as those specified in Federal regulations for prime farmland soils. The soils found to be suitable for big sagebrush and mountain shrub reestablishment would have to be stored separately. The material could not be mixed with soil salvaged for reclamation of the Atriplex-dominated sites. Direct hauling should prevent the general mixing of soil materials, but early in the operation some storage would be required.

Topography.--Red Rim has a complex topographic system in its premining state, and some of these microtopographic features would be lost in the postmining landscape. The topography has minimally two components which are of critical concern to big sagebrush distribution on the Red Rim tract: smaller pockets where the snow accumulates and where the much larger big sagebrush (probably basin big sagebrush) occurs, and the windswept ridges some of which are dominated by a much smaller form of big sagebrush (probably Wyoming big sagebrush). The construction of snow accumulation pockets in the topography would be expensive but could be accomplished. The larger windblown ridges present a separate problem. Detailed geomorphic studies would have to be conducted prior to development of the mining plan. Such reclamation activities as the selective placement of coarse materials (6 to 12 inches in diameter) along ridge crests and the development of stone terraces or rock walls and other structures to break long slopes in steep areas are possibilities for reclamation. Irwin and others' (1983) Red Rim pronghorn study found that pronghorn concentrated on slopes in the 25 to 55 percent range. Any attempt to reconstruct such steep slopes would require extremely careful design and management. Revegetating such slopes would be difficult and expensive. Reestablishing Wyoming big sagebrush communities on these areas while at the same time trying to provide sufficient vegetative cover to stabilize the slopes would be particularly difficult, because competition from grasses and forbs must be limited in order to establish big sagebrush.

The availability of the required forage to support the pronghorn during critical winter periods is closely related to the topography of the premining landscape. It would not be sufficient to produce the forage on the reclaimed landscape, it would also have to be available to the pronghorn during critical periods. Little is known about the specific relationships between the topography of the Red Rim area and snow distribution. Certainly the orientation of ridges relative to gradient as well as the roughness of the surface would influence the pattern of snow deposition. The existing ridges have very steep side slopes with slopes ranging from 15 to greater than 60 percent. Some of the ridges have relatively flat tops ranging in width from a few feet to hundreds of yards. In every case examined on the Red Rim site, the presence of the ridge is controlled by the presence of bedrock materials. Such conditions are characteristic of this portion of Wyoming and many other arid regions.

High wind velocities on the site redistribute much of the snow throughout the tract. If, as is expected, the steeper north- and northeastern-facing slopes do accumulate additional snow and are strongly correlated with the presence of the basin big sagebrush, then construction of similar landscape configurations would have to be accomplished. The areas are not generally large, currently averaging between 0.5 and 5 acres. The location of such areas would not have to be precisely the same in the postmining landscape as in the premining environment, but they would have to be developed with minesoil construction criteria and materials identified earlier in this reclamation scenario. To aid in the reconstruction of this plant community type, particular attention would have to be paid to the size of the areas and their position and distribution in the landscape.

A detailed study and evaluation of the premining topography as it relates to the distribution of plant communities and pronghorn habitat utilization would be needed. Identification of the components of the system which allow redistribution of snow are critically important. The revegetation/stabilization effort would be much simplified if it is found that slopes reconstructed at a lower gradient would still allow the wind to remove snow and support the Wyoming big sagebrush plant community type.

The baseline study requirements (Nos. 4 and 5) include a major effort to determine the characteristics of the topographic features which apparently control availability of pronghorn forage during critical periods. It would be essential to define their existing characteristics, then determine if they could be duplicated during the reclamation process. Ideally, topographic features could be constructed which would allow similar snow conditions to develop but which would be inherently more stable than the existing features. The most difficult set of problems related to mitigation of impacts on the pronghorn would be the establishment of the appropriate vegetative cover on the proper topography to allow access to the forage by pronghorn. This problem would be compounded by the inherent instability of unconsolidated materials in this environment--minesoil/spoil substrates which are relatively loose when compared to the induration of the sandstones which are important in controlling many of the landscape features on Red Rim. It would be expensive but not difficult to construct the required postmining topography. The difficulty would come with the need to stabilize the features.

Vegetation and Reclamation.--The vegetation inventory should be accomplished at a scale of 1:400 or larger scale, and, most importantly, the design of the legends should relect this scale of mapping. The identification, classification, and establishment of plant communities should be made on an objective basis through the use of similarity matrices, histograms, and ordination or similar analytical techniques. References for such work are included in Mueller-Dombois (1974), Thilenius (1972), and Prodgers (1983). Cover, frequency, and production data would have to be acquired by species for each of the existing plant communities established. According to Prodgers (1983), production data by community type would have to be developed for a minimum of 2 years prior to disturbance of the site. OSM and Wyoming DEQ regulations currently require that 1 year of baseline data be collected at a proposed minesite.

The baseline vegetative information would serve as the basis for the development or isolation of the types of plant communities to be restored in the postmining landscape. From reviewing the available quantitative information from the Red Rim tract, it appears that, at a minimum, the following reclaimed communities should be developed: basin big sagebrush and wheatgrasses; Wyoming big sagebrush, Sandberg bluegrass, and wheatgrasses; shadscale, Gardner and fourwing saltbush; and the mountain shrubs.

By this stage in the development of the revegetation program under this reclamation scenario, a large amount of data would have been collected. These data would have to be built into the planning process and tracked throughout the monitoring of revegetation success. The first step would be to analyze the soil and vegetation inventory information to determine the range of soil characteristics associated with each of the plant community types identified in the Red Rim site vegetation inventory. For example, evaluation of the literature and much field experience would suggest that, for revegetation with the two subspecies of big sagebrush (basin and Wyoming big sagebrush), the following soil conditions would have to exist: clay contents between 24 and 45 percent, conductivity measurements below 6 mmhos/cm, and exchangeable sodium percentages below 8, but the latter has to be evaluated for the total amount of clay and for mineralogy. Soil depth should exceed 24 inches over the overburden for the basin big sagebrush, whereas it could be considerably less for the Wyoming big sagebrush (Beetle and Young, 1965). A detailed literature search to develop amplitudes of soil adaptability for the dominant species would be required and would have to be integrated with a thorough evaluation of the soil and vegetation data collected from the site. The latter would be of much greater importance in the planning phase because it makes allowances for local conditions and ecotypes of the big sagebrush species/subspecies. The literature search would be important in that it would allow one to not be confused by historical use patterns and localized events which might tend to distort the onsite soil and plant community evaluation. Having determined the range of soil characteristics suited for the primary plant species in a plant community, the planner could then project the type of minesoil needed to support a specific plant community. A word of caution--the minesoils could not be designed around the periphery of the range of characteristics but would have to fall well within the middle portion of the range, since seeding and plant establishment would be inherently uncertain with the low levels of precipitation on this petition area.

The plant species edaphic literature search should be supported by a synecological search for the dominant plant communities. Combining this type of data with the quantitative work done on the existing plant communities on the Red Rim tract would provide a reasonable understanding of the communities' composition, cover, vigor, and a limited definition of the seral stages. A large number of plant species could be obtained for revegetation efforts either as seed or nursery stock. The availability of plant materials for the species that make up the major portion of the plant communities being reestablished would have to be determined. A list of available seeding mixes, nursery stock, and salvage materials for the revegetation effort could be compiled, and, from this, the type and format for the revegetation effort could be developed.

The petition addresses, in particular, the difficulties of reestablishment of the big sagebrush types. To date, very little consistent success has occurred when seeding big sagebrush on minesoils (Howard and others, 1977; Joe Coenenberg, Western Energy Company, Colstrip, Montana, oral communication, 1983). Kevin Allred (Native Plants, Inc., Salt Lake City, Utah, oral communication, 1983) has suggested that the lack of success has come, in part, from competition with forbs and grasses for the shallow surface moisture during the first few growing seasons. In several instances, the lack of success can be attributed to seeding on less than optimal minesoils. To partially overcome this problem, several different options are available to the reclamationist: seeding forbs and shrubs, and grasses in alternate boxes on the range drill; seeding big sagebrush in the fall and interseeding grasses in the spring or fall of the following year, relying primarily on the use of tubelings for establishment of the shrub types; and early and limited use of irrigation to enable establishment of the young shrubs. Mulching would serve to prevent direct contact of the desiccating winds with the soil surface or young shrub plants and would increase shrub survival and establishment. All or most of these kinds of practices would have to be implemented to increase the probabilities of big sagebrush establishment by seeding.

One of the most promising methods of establishing big sagebrush is through the use of containerized tubelings. They are relatively low in cost and, given the development of minesoils as prescribed above, should succeed in most years. The extremely arid environment on Red Rim leaves very little margin for seedling survival, as a deviation of 2 or 3 inches from the normal precipitation could result in a total loss of the transplanted material. Small amounts of carefully designed irrigation to enhance shrub seedling survival through the first or second year would be valuable in developing the sagebrush communities on the minesoils. Care would have to be exercised not to irrigate so heavily that the distribution of roots would begin to reflect that of the total moisture rather than that which would be required by those plants growing under natural precipitation.

RME (1982c) conducted a study on the potential of transplanting, via a tree spade, relatively large big sagebrush plants into a disturbed area. A short review of this work is included in OSM's responses to petition allegations in chapter IV. The extensive use of this method to reestablish premining big sagebrush densities is not feasible economically or environmentally (Dave Preston and Elroy Taylor, Rocky Mountain Energy Company, oral communications, 1983). However, transplanting big sagebrush plants into minesoils suited to their development could have real benefits and would be essential to accomplishment of reclamation scenario 1. The numbers of transplants would be limited to those which could be salvaged at the time of topsoil removal in areas being prepared for mining. The transplanting of relatively mature plants could promote the establishment of volunteer big sagebrush plants.

Monitoring would be one of the keys to the long-term success of the revegetation effort. The program should include the establishment of both permanent transects and randomized plots within each of the postmining community types. Parameters evaluated should include absolute cover and frequency for all species, as well as density data for the shrubs and half-shrubs. (The term "half-shrubs" is widely used in RME's vegetation reports.) Production data should be collected, starting the third year and carried forward until bond release. Carefully collected and monitored precipitation, evaporation, and wind-direction/speed records should be maintained on the site. Since the entire area of the mine would not be disturbed at the same time, such data would enable the reclamation planner and regulators to make adjustments in the reclamation efforts and to mitigate major losses that might occur in the previously revegetated strips. Such data, if carefully collected, would contribute greatly to the understanding of this type of reclamation.

Under optimal conditions, a revegetated mine area could support the same level of pronghorn use in 10 to 12 years. This assessment is based primarily on best professional judgment of Scott Fisher, Revegetation Specialist, OSM. The plant community developing during the first year after seeding is often dominated by weedy species which, under good growing conditions and management, should dissipate in the second and third seasons. Experience has shown that the better adapted grasses would become well established during the second year with root and cover expansion continuing for the next few years. Shrubs, which are of primary concern on Red Rim by virtue of their importance for pronghorn, are relatively slow to establish from seed and to reach their full mature stature. Difficulties in establishment and slow growth of many shrubs have led to widespread use of tubelings and transplants (Crofts and Carlson, 1982). Generally, the larger the plant introduced, the quicker the plant reaches full stature. The underlying revegetation premise of reclamation scenario 1 is to restore the area to premining carrying capacity for pronghorn through a revegetation plan featuring somewhat reduced shrub densities but with cover and production values equal to or greater than the premining condition. To accomplish recovery in 10 to 12 years, such a plan would require relatively mature big sagebrush plants (i.e., transplants and tubelings). In arriving at the 10- to 12-year estimate, it is anticipated that big sagebrush transplants, tubelings, and plants from seeds would develop at a rate comparable to those growing in native environments and that growing conditions would be favorable. It should, however, be recognized that an extremely large number of variables, including minesoil characteristics, precipitation, density of planting, seed source, effective moisture, competition with surrounding species, and the genetic characteristics of the acquisition, would influence the establishment and growth rate of the big sagebrush plants.

Postmining Land Management.--Describing the requirements for the postmining land management is most difficult. The pronghorn, rabbit, and deer populations would pose an immediate threat to the survival of the shrub species established from seed or transplanted by means of containerized tubelings. It could be difficult to prevent these types of losses, but the seeding and transplanting densities could be increased to allow for some losses. Considering the pronghorn population which would be present, feral stock would have to be excluded from the revegetating areas until the shrub species have become fully established, roughly estimated at approximately 10 years, but perhaps as long as 12 to 25 years, to avoid damage to the developing plant communities. A successful revegetation effort would result in increased production on the minesoils of grasses, which are the primary dietary component for cattle. Given the low existing production of forage for cattle on the site, the latter would not be difficult to accomplish.

Risks and Uncertainties.--A basic issue in the petition is that of the level of risk found in the potential for reclamation/reestablishment of critical pronghorn habitat if leasing and mining of the tract is allowed. The probability that the procedures and techniques identified in reclamation scenario 1 would succeed can only be estimated (based on professional judgment). Initially, the goals for reclamation would have to be very clearly defined and quantified. The baseline inventories, quality control procedures and research efforts could be accomplished without much fear of failure. The full integration of the resulting data into the planning process and the resultant reclamation plan would have a much higher risk of failure. Such detailed planning efforts are not frequently undertaken and major risks would be associated with the effort. Equipped with the goals and the planning products, the execution phase would become the next critical component of the reclamation/mitigation effort, and perhaps the source of greatest risk. The intensity and dedication with which the operating company would pursue the reclamation effort would, in many respects, determine the success of the program. The vigor with which the regulatory authorities would inspect and enforce the mining plan are very important components of this phase of the program.

Careful timing or sequencing of reclamation activities would be critical to accomplish the task. Currently, sufficient time exists to institute the required studies and baseline inventory efforts to fill the many existing informational gaps relative to the establishment of the reclamation goals and the planning effort. Some uncertainty would exist that the required research efforts might not develop appropriate techniques to mitigate/restore the critical pronghorn habitat. However, an even greater risk exists that such studies could not be started with sufficient time for completion and data utilization, that their designs are not appropriate, they would not be adequately funded, or that the data would not be properly evaluated with results being integrated into the reclamation planning process.

Attempts to establish any plant community are susceptible to the vagaries of the climate, but this factor becomes even more importaant in the harsh environment of the Red Rim site. Such climatically induced potential losses would have to be accepted and dealt with directly in the reclamation planning process. Contingency plans should be constructed in advance. One of the required studies prior to permit issuance would be the development of mitigation measures or recovery techniques to offset plant establishment losses due to abnormal climatic events. The feasibility or potential for use of irrigation should become a critical portion of the reclamation plan, although precipitation or available soil moisture would not be the only controlling climatic factor in plant establishment on Red Rim.

Reclamation Scenario 3

Objective.--Revegetation and reclamation activities based on redevelopment of the livestock carrying capacity with ancillary efforts to meet the critical winter habitat of the pronghorn.

The goals include the development of a cool season grass-dominated reclaimed vegetation with complimentary shrubs where possible. The shrub species would be dominated by fourwing saltbush and winterfat, which are the two shrub species most easily established in the region. Sagebrush (Artemesia tridentata ssp. wyomingensis) seedings could be attempted and even augmented by use of a limited number of tublings or transplants to offset the loss of pronghorn habitat. However, the revegetation effort would be primarily directed toward production of forage for livestock rather than pronghorn. Less emphasis would be placed on the pographic restoration than in reclamation scenario 1 and the probabilities for revegetation success would be higher, if for no other reason than the more restricted use of big sagebrush and lack of emphasis on restoration of the premine topography.

The dominant reclamation goal would be to return the land to its capacity for forage production for use by livestock with limited mitigation of habitat loss by pronghorn, which corresponds to BLM's general multiple use land management concept. The reclamation effort would utilize techniques in current widespread use, predominantly native seed sources, some shaping of the postmining topography to trap snow and concentrate moisture generally meeting the existing concept of approximate original contour, topsoil salvaging with limited storage, and restricted efforts to meet the pronghorn habitat needs. Baseline inventory, planning and reclamation efforts would be in general conformity with existing practices and guidelines/regulations.

Overburden, Soil, and Vegetation.--The premining inventory intensities, scales, and interpretations for soil and vegetation should be slightly more detailed and better documented than is the current practice. The acreage of big sagebrush to be reestablished would require careful selection of soil and overburden materials for minesoil construction. The limited amount of topsoil and subsoil available for reestablishment of these types would require relatively detailed inventories. The overburden analysis would be limited to the parameters in the current Wyoming guidelines, but with emphasis on the identification of acid-forming, toxic (boron and selenium are of particular concern), saline, and/or alkaline materials. Experience in the region suggests potential problems with acid minesoils developing from the pyritic overburden.

A generalized premining topographic analysis and study would be needed to allow the limited reconstruction of the premining topography important to the pronghorn. Such an effort would receive much less emphasis than in reclamation scenario 1, with small portions of the ridge complex terrain being reconstructed. The use of general seed mixes on much of the tract would limit the need for special handling of soil materials, the inventory and detailed planning requirements, and the intensive revegetation efforts to produce plant communities required specifically for the pronghorn. Where shrubs are needed, the amount of grass and forbs would have to be reduced, or staggered seeding methods (Coenenberg, 1982) would have to be used to prevent, as much as possible, competition with the seedling shrubs. Very limited use of sagebrush transplants and tublings would be made and confined to areas where minesoils had been constructed to meet the requirements of the subspecies. Use of the above methods in islands or small areas within the larger cool season grass-dominated type could facilitate colonization of the disturbed area by sagebrush plants, but there are no specific data to indicate the extent to which this would take place or the length of time that would be required. Common sense would suggest that the availability of a plant materials source, such as these islands, would facilitate establishment of the species. Direct hauling of the salvaged topsoil would also enhance the opportunity for establishment of native shrubs, particularly big sagebrush.

Current reclamation operations generally develop a planar type of slope which would not represent the complexity of the slope patterns found on the Red Rim area. Utilizing the mining practices being widely applied today, it seems highly unlikely that the original contour would be duplicated with respect to the complexity and orientation of slopes.

Monitoring requirements would be less intensive or critical than in reclamation scenario 1. Sampling of either, or both, the minesoils and regraded spoils would be of importance, particularly in reference to potentially acid-forming and toxic material contents in the overburden/spoil complex. Long-term monitoring of the revegetation effort would be of importance in modifying the program, attempting to understand the direction of successionary change, and attempting to establish the potential for achieving revegetation success.

Postmining land use requirements remain relatively unknown as is the case with other reclaimed lands in the region. Given the limited and general knowledge available about the premining soils and overburden materials, it would be safe to assume that considerable restriction on the numbers of livestock and the seasonality of use would have to be practiced in the years immediately following bond release. If full or excessive utilization by livestock takes place immediately after bond release, major soil erosion and gullying could be expected.

Risks and Uncertainties.--The risks associated with reclamation scenario 3 are limited, as it is the standard type of reclamation currently being conducted in Wyoming. The postmining plant community would be composed primarily of cool season grasses with limited establishment of winterfat and fourwing saltbush. Such establishment would be open to some risk but, in general, could be accomplished. The product would meet only a minor portion of the critical winter range requirements.

Table F-1.—Matrix and analysis of two reclamation scenarios developed for the Red Rim petition area

Reclamation goals	Past experience	Probability of successful revegetation and rehabilitation of pronghorn critical winter range	Summary of impacts on pronghorn
		Reclamation scenario 1	
Re-create pronghorn critical winter range; revegetate similar to premine environment shrub communities which are very similar to those in premine ecosystem; lesser shrub density but absolute cover values similar to premine condition; little change in shrub composition with revegetation of big sagebrush community types stressed; detailed baseline analysis; selective handling of soils; topography of mined area returned to a condition which functions as nearly as possible to the existing landscape especially re-creating narrow draws where present, major drainages, and slopes of similar aspect and drainage.	New concepts and ideas being implemented on a large-scale basis for the first time; fundamentally sound scientific basis for the actions being taken; would require absolute dedication to the project by the lessee and trained reclamationists. There are no quantitative data available to dictate the precise designs and numbers of topographic features and other reclamation components required.	Reconstruction and stabilization of premining topography and stabilizing the system would be very difficult to accomplish; reconstruction of the original topography should make shrubs and shelter available for pronghorn; revegetation of windblown ridges and slopes will be most difficult; selecting seed from the Red Rim tract will offset some of the risks concerning palatability and nutritive value of the shrubs used in revegetation; frequency and severity of subnormal precipitation is of great concern and could potentially result in loss of several years' reclamation; level of committment and expertise of mine operator are a significant part of the risk; more stringent control of postmine use will be required for long-term success; risks in attaining reclamation goals are much higher than in reclamation scenario 3; owing to the checkerboard ownership and different reclamation goals, it is questionable whether stable geomorphic conditions, drainage reestablishment, and slope conditions can be accomplished on every other section (reclamation scenario 2).	Habitats would be disturbed and reclaimed in parcels; species diversity and abundance of shrub-dominated communities would be altered; the disturbance and reclamation of pronghorn critical winter range would mean a short-term reduction of carrying capacity for pronghorn on those lands; increased human activity in the area would result in more harrassment, poaching, and road kills.
		Reclamation scenario 3	
Revegetate mined lands to some use by pronghorn but with emphasis on multiple use providing forage for livestock and wildlife; perennial cool season grasses and shrubs would be dominant vegetative communities; revegetation plan would be primarily seed-based vegetation; some planted sagebrush would be used; direct hauling of topsoil would be necessary to aid the reestablishment of native shrubs; topography would be generally returned to approximate original contour with less diversity than premine condition; aspects of hillslopes would be altered.	Considerable. The Red Rim tract has some unique features and the type of revegetation would require some new or infrequently applied technologies, but it is well within the experience range of professionals in Montana and Wyoming.	Reclaimed land would meet few of the needs of pronghorn but would not reconstruct critical winter habitat; topography (AOC) would be considerably different from existing conditions; suitable exposure and sheltered areas may exist on reclaimed areas but at a lower level than premine condition; postmine vegetation would provide limited forage and habitat for pronghorn; Wyoming big sagebrush could spread to provide additional forage; frequency and severity of subnormal precipitation is of concern and could potentially result in loss of several years' reclamation; careful regulation of postmine land use critical to maintaining those shrubs which are reestablished.	Habitat would be disturbed and reclaimed in parcels; the diversity and abundance of shrub-dominated habitats would be altered; reclaimed land would have reduced value for wintering pronghorn and Red Rim's carrying capacity would be significantly reduced for the long term; increased competition for less habitat could lead to more pronghorn mortality during winter; Wyoming GFD may further reduce population objective based on the new, lower carrying capacity; increased human activity would lead to more disturbance, poaching, and road kills.

APPENDIX G

PETITION-AREA SOILS INFORMATION

Table G-1.--Soil map units of the Red Rim area

(Source: Stephens, 1976)

Depth

D = Deep, over 40 inches
MD = Moderately deep, 20-40 inches
Sw = Shallow, 10-20 inches
VSw = Very shallow, less than 10 inches

Surface texture

C = Clay
CL = Clay loam
SiCL = Silty clay loam
L = Loam
SL = Sandy loam
FSL = Fine sandy loam
LS = Loamy sand
FS = Fine sand

Map symbol	Map units and percent composition	Slope (percent)	Precipitation zone (inches)	Acres[1]	Percentage of total
207	Delphill-Blazon Association: 50 percent MDSiCL 30 percent SwSiCL 20 percent VSwL, SwSL, rock outcrop	6-30	10-14	631	3.3
210	Patent-Forelle Association: 90 percent DL 10 percent SwL	3-15	10-14	13	.1
225	Cushool-Rock River Sandy Loams: 50 percent MDSL 30 percent DSL 20 percent DL, MDL, DSL, MDSL, DLS	3-10	10-14	1,569	8.3
226	Rock River-Ryark-Patent Complex: 30 percent DSL 30 percent DLS 20 percent DL 20 percent DSL, LS	3-15	10-14	168	.9

Table G-1.--Soil map units of the Red Rim area--Continued

Map symbol	Map units and percent composition	Slope (percent)	Precipitation zone (inches)	Acres[1]	Percentage of total
228	Cothran-Spool-Rock Outcrop Complex: 35 percent DFS 25 percent SwLS 15 percent sandstone outcrop 25 percent MDFS	10-30	10-14	98	.5
229	Cushool-Cushool Red Variant Association: 40 percent MDSL 40 percent MDLS 20 percent D, MD, SwSL	3-9	10-14	2,190	11.5
230	Cushool Red Variant-Cothran-Spool Complex: 30 percent MDLS 20 percent DFS 20 percent MDLS 30 percent MDFS, LS; sandstone ledges	6-20	10-14	1,369	7.2
231	Rock River-Cushool-Ryark Association: 40 percent DSL 25 percent MDSL 15 percent DLS 20 percent D, MDFS	3-15	10-14	664	3.5
232	Blazon-Delphill-Diamondville Complex: 50 percent SwSiCL 30 percent MDL 20 percent D and VSwL	6-30	10-14	1,941	10.3
233	Forelle-Patent Complex: 40 percent DL (3 inches surface loam, then clay loam) 30 percent DL 30 percent D, MD, SL, LS	3-10	10-14	218	1.1

Table G-1.--Soil map units of the Red Rim area--Continued

Map symbol	Map units and percent composition	Slope (percent)	Precipitation zone (inches)	Acres[1]	Percentage of total
235	Blazon-Shinbara Complex: 45 percent SwL 30 percent VSwL 25 percent MDL, SL; SwCL; rock outcrop	6-40	10-14	104	.6
236	Cushool-Worfman-Blackhall Complex: 40 percent SwSL 35 percent MDLS 25 percent DSL, SwL, C	6-30	10-14	374	2.0
237	Seaverson-Blazon Complex: 40 percent SwCL 30 percent SwL 10 percent VSwL 20 percent MDSiCL, L; rock outcrop	3-15	10-14	201	1.1
241	Diamondville-Blazon-Forelle Complex: 40 percent MDL 20 percent DL 20 percent SwL 10 percent SwSL 10 percent MD and SwCL, L	3-15	10-14	646	3.4
243	Forelle-Havre Association: 50 percent DL 50 percent DL (CL below 3 inches)	0-3	10-14	41	.2
252	Shinbara-Blazon-Rock Outcrop Complex: 40 percent VSwL 30 percent SwL 15 percent rock outcrop 15 percent SwCL, SL; MDLS	10-50	10-14	777	4.1

Table G-1.--Soil map units of the Red Rim area--Continued

Map symbol	Map units and percent composition	Slope (percent)	Precipitation zone (inches)	Acres[1]	Percentage of total
258	Rock River-Satanka Association: 45 percent DSL 35 percent MDSL 20 percent SwL, SL, rock outcrop	3-9	10-14	19	.1
260	Ryan Park-Rock River Complex: 45 percent DFSL 30 percent D alkaline L 25 percent MD to DL or FSL	2-20	10-14	214	1.1
300	Laney Variant-Monte Complex: 35 percent DC (saline subirrigated) 30 percent DL (strongly alkaline and saline) 35 percent SwSL, DSL, DL (saline)	0-10	7-9	561	3.0
307	Garsid-Haterton Association: 50 percent MDL 30 percent SwL 10 percent DL 5 percent SwSL 5 percent VSw channery CL	3-30	7-9	339	1.8
310	Haterton-Garsid-Hatermus Complex: 30 percent SwL 25 percent MDL 20 percent SwL, CL (saline) 25 percent DL (saline), SwC, limestone outcrop	6-20	7-9	775	4.1

Table G-1.--Soil map units of the Red Rim area--Continued

Map symbol	Map units and percent composition	Slope (percent)	Precipitation zone (inches)	Acres[1]	Percentage of total
312	Huguston-Kandaly Complex: 40 percent SwFSL 30 percent MDLS 30 percent SwL, SL; MDLS, sandstone	6-20	7-9	109	.6
313	Monte, Saline-Debone Complex: 40 percent DL (saline) 30 percent DSL 30 percent DL; strongly alkaline, barren areas; narrow drainageways	3-10	7-9	374	2.0
314	Monte Loam: 75 percent DL 15 percent SwL 10 percent MDL	3-10	7-9	70	.4
315	Monte-Haterton Association: 50 percent DL 35 percent SwL 15 percent D, MD, SwL	3-20	7-9	3,170	16.7
316	Haterton-Huguston-Rockland Complex: 30 percent SwL 30 percent SwSL 25 percent rockland 15 percent L (saline), SwC, Sw channery soils	10-30	7-9	1,135	6.0
317	Littsan Variant-Dunkle Complex: 75 percent DSL 25 percent DL (saline), DSL	3-10	7-9	59	.3

Table G-1.--Soil map units of the Red Rim area--Continued

Map symbol	Map units and percent composition	Slope (percent)	Precipitation zone (inches)	Acres[1]	Percentage of total
320	Monte-Clowers Complex: 75 percent DL (saline) 25 percent DSL alluvium, D wet saline soils	0-3	7-9	292	1.5
321	Dunkle-Screggs Complex: 45 percent DSL 35 percent MDSL 20 percent MDSL, DSL, sand dunes	1-15	7-9	738	3.9
403	Aquepts-Fluvents: 40 percent DLS to C wetlands 40 percent DLS to C subirrigated 20 percent D saline subirrigated, lowland terraces, alluvial fans	0-3	7-9	67	.4
Totals				18,926	100.0

[1] Acreage figures are approximate. Due to methodology in calculating soil areas, soils total acreage in this table differs 2.7 percent from actual 19,452-acre petition area total.

Table G-2.--Classification of soil series recognized in the Red Rim soil survey (Stephens, 1976)

(Sources: Young, 1983; Soil Survey Staff, 1978)

Soil series[1]	Soil family characteristics and subgroup designations
Blackhall: WY	Loamy, mixed (calcareous), frigid, shallow.[3] Ustic Torriorthents.[4]
Blazon: WY	Loamy, mixed (calcareous), frigid, shallow. Ustic Torriorthents.
Clowers: WY	Fine-loamy, mixed (calcareous), frigid. Typic Torrifluvents.
Cothran	Series not recognized by SCS.
Cushool: WY[2]	Fine-loamy, mixed. Borollic Haplargids.
Cushool, red variant	As in Cushool.
De Bone: WY[2]	Fine, montmorillonitic, frigid. Typic Natrargids.
De Bone, saline variant	As in De Bone.
Delphill: MT	Fine-loamy, mixed (calcareous), frigid. Ustic Torriorthents.
Diamondville: WY	Fine-loamy, mixed. Borollic Haplargids.
Dunkle	Coarse-loamy, mixed. Borollic Camborthid.
Forelle: WY	Fine-loamy, mixed. Borollic Haplargids.
Garsid: WY[2]	Fine-loamy, mixed (calcareous), frigid. Typic Torriorthents.
Hatermus: WY[2]	Loamy, mixed (calcareous), frigid. Typic Torriorthents.
Haterton: WY[2]	Loamy, mixed (calcareous), frigid. Typic Torriorthents.
Havre	Fine-loamy, mixed (calcareous), frigid. Ustic Torrifluvents.

Table G-2.--Classification of soil series recognized in the Red Rim soil survey (Stephens, 1976)--Continued

Soil series[1]	Soil family characteristics and subgroup designations
Horsley: WY[2]	Loamy, mixed (calcareous), frigid. Typic Torriorthents.
Huguston: WY[2]	Loamy, mixed (calcareous), frigid, shallow. Typic Torriorthents.
Kandaly	Mixed, frigid. Typic Torripsamment.
Laney variant (Laney): WY	Fine-loamy, mixed (calcareous), frigid. Typic Torrifluvents.
Littsan variant (Littsan): WY[2]	Coarse-loamy, mixed, frigid. Typic Haplargids.
Monte: CO	Fine-loamy, mixed (calcareous), frigid. Typic Torriorthents.
Patent: ND	Fine-loamy, mixed (calcareous), frigid. Ustic Torriorthents.
Rock River: WY	Fine-loamy, mixed. Borollic Haplargids.
Ryan Park: WY	Coarse-loamy, mixed. Borollic Haplargids.
Ryark: WY[2]	Coarse-loamy, mixed. Borollic Haplargids.
Santanka: WY[2]	Fine-loamy, mixed. Borollic Haplargids.
Screggs	Coarse-loamy, mixed. Borollic Camborthid.
Seaverson: WY[2]	Loamy, mixed (calcareous), frigid, shallow. Ustic Torriorthents.
Shinbara: WY[2]	Loamy, mixed (calcareous), frigid, shallow. Ustic Torriorthents.

Table G-2.--Classification of soil series recognized in the Red Rim soil survey (Stephens, 1976)--Continued

Soil series[1]	Soil family characteristics and subgroup designations
Spool: WY[2]	Mixed, frigid. Lithic Torripsamment.
Worfman: WY[2]	Loamy, mixed, shallow. Borollic Haplargids.

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[1] Where indicated, state named following soil series is the state where the series was first recognized.

[2] Tentative soil series.

[3] Family characteristics.

[4] Subgroup designations.

Table G-3.--Soil interpretations for soil series identified in the Red Rim order three soil survey (Stephens, 1976)

(Source: Soil Conservation Service soil interpretation records (form 5). See table G-4 for the Soil Conservation Service's definition of topsoil and table G-5 for a description of the chemical and physical properties of topsoil suitability categories for revegetation)

Soil series	Soil depth (in.)[1]	Topsoil suitability[1]	Surface erosion factors		Wind erodibility group	Potential plant production						Wildlife habitat suitability		
						Low PE* (dry)			High PE* (moist)			Potential habitat elements		Potential as habitat for rangeland wildlife
			K[2]	T[3]		Fav. yrs.	Norm. yrs.	Unfav. yrs.	Fav. yrs.	Norm. yrs.	Unfav. yrs.	Wild herb.	Shrubs	
Blackhall	<20	Poor	0.32	0.2	3	700	500	350	1,680	1,400	980	Fair	Fair	Fair
Blazon	<20	Poor	0.43	2	4L	1,000	750	500	1,000	750	500	Fair	Fair	Fair
Clowers[4]														
Cothran[4]														
Couthan[4]														
Cushool	20-40	Poor	0.24	3	3	1,400	1,100	600	1,400	1,100	600	Fair	Fair	Fair
De Bone	>60	Poor	0.32	5	3	600	450	300	600	450	300	Poor	Poor	Poor
Delphill	20-40	Fair	0.32	3	5 or 7	1,100	800	500	1,100	800	500	Fair	Fair	Fair
Diamondville	20-40	Moderate to severe	0.28	2	3	2,000	1,500	850	2,000	1,500	850	Good	Fair	Good
Dunkle[4]														
Forelle	>40	Fair to poor	0.20	5	3	1,200	900	600	1,400	1,100	600	Fair	Fair	Fair
Garsid	20-40	Poor	0.32	3	4L	700	500	300	700	500	300	Poor	Poor	Poor
Hatermus	<20	Poor	0.49	1	4L	450	350	200	450	350	200	Poor	Poor	Poor
Haterton	<20	Poor	0.37	2	4L	450	350	200	450	350	200	Poor	Poor	Poor
Havre	>60	Good	0.28	5	4L	2,000	1,600	1,500	2,000	1,600	1,500	Fair	Fair	Fair
Horsley	<20	Poor	0.15	1	4L	350	250	150	350	250	150	Very poor	Very poor	Very poor
Huguston	<20	Poor	0.32	2	3	450	350	250	450	350	250	Poor	Poor	Poor
Kandaly	>60	Poor	0.28	5	1	700	500	350	700	500	350	Poor	Poor	Poor
Laney	>60	Poor	0.32	5	4L	600	450	300	600	450	300	Poor	Poor	Poor

Table G-3.--Soil interpretations for soil series identified in the Red Rim order three soil survey (Stephens, 1976)--Continued

Soil series	Soil depth (in.)[1]	Topsoil suit-ability[1]	Surface erosion factors		Wind erodibility group	Potential plant production						Wildlife habitat suitability		
						Low PE* (dry)			High PE* (moist)			Potential habitat elements		Potential as habitat for rangeland wildlife
			K[2]	T[3]		Fav. yrs.	Norm. yrs.	Unfav. yrs.	Fav. yrs.	Norm. yrs.	Unfav. yrs.	Wild herb.	Shrubs	
Littsan[4]														
Monte[4]														
Patent	>60	Fair	0.32	5	4L	1,100	800	500	1,000	800	500	Fair	Fair	Fair
Rock River	>60	Poor	0.20	5	3	1,500	1,200	700	1,500	1,200	700	Fair	Fair	Fair
Ryan Park	>60	Fair	0.32	5	2	1,200	1,000	700	1,500	1,200	700	Fair	Fair	Fair
Ryark	>60	Poor	0.15	3	2	1,500	1,200	700	1,500	1,200	700	Fair	Fair	Fair
Satanka	20-40	Fair to poor	0.37	3	3	1,400	1,100	600	1,400	1,100	600	Fair	Fair	Fair
Scruggs[4]														
Seaverson	<20	Poor	0.49	2	6	500	350	250	500	350	250	Very poor	Very poor	Very poor
Shinbara	<20	Poor	0.37	1	4L	600	450	250	600	450	250	Poor	Poor	Poor
Spool[4]														
Worfman[4]														

* PE = Precipitation evaporation ratio; numbers in columns are in lb/acre dry weight.

[1] **Note: Wyoming DEQ policy on suitability depths and quality of topsoil differs from that presented in table.**

[2] K = Soil erodibility factor.

[3] T = Erosion tolerance value.

[4] Soil Conservation Service soil interpretation records (form 5) not available for this series.

Table G-4.--Soil Conservation Service's definition of "topsoil"[1]

(Source: National Soil Handbook, Part II, Section 403.3(d))

"Topsoil. The term 'topsoil' has several meanings, but as used here, the term describes soil material used to cover an area so as to improve soil conditions for establishment and maintenance of adapted vegetation.

"Generally the organic rich upper part of the soil is most desirable, however, material excavated from deeper layers is also used. In this rating, the upper 40 inches of soil material is evaluated for its use as topsoil. In the borrow area, the material below 40 inches is evaluated for its suitability to grow vegetation after the upper 40 inches is removed.

"The soil properties that are used to rate the soil as topsoil are those that influence plant growth, the east of excavation, loading and spreading, and those which influence the reclamation of the borrow area.

"The physical and chemical soil properties that influence plant growth are the presence of toxic substances, soil reaction, and those properties which are inferred from the soil texture such as available water capacity and fertility. The properties that influence the ease of excavation, loading, and spreading are the amounts of rock fragments, slope, depth to the water table, soil texture, and thickness of suitable material. The properties that influence the reclamation of the borrow area are slope, depth to water table, amount of rock fragments, depth to rock, and the presence of toxic material."

---

[1] This topsoil definition differs significantly from that developed by Wyoming DEQ. Wyoming DEQ Rules and Regulations define topsoil as all suitable A, B, and C horizon material.

Table G-5.--Chemical and physical properties of topsoil[1] that determine its suitability for revegetation

Property	Limits			Restrictive feature
	Good	Fair	Poor	
Depth to bedrock (inches)	greater than 40	20 - 40	less than 20	Area reclaim.
Depth to cemented pan (inches)	greater than 40	20 - 40	less than 20	Area reclaim.
Depth to bulk density greater than 1.8 (G/CC) (inches)	greater than 40	20 - 40	less than 20	Area reclaim.
USDA texture (0 - 40 inches)	---	LCOS, LS, LFS, LVFS	COS, S, FS, VFS	Too sandy.
USDA texture (0 - 40 inches)	---	SCL, CL, SICL[3]	SIC, C, SC	Too clayey.
USDA texture (0 - 40 inches)	---	---	FB, HM, SP, MPT, MUCK, PEAT, CE	Excess humus.
Fraction greater than 3 inches (weighted percent):[2]				
0 - 40 inches	less than 5	5 - 25	greater than 25	Large stones.
40 - 60 inches	less than 15	15 - 30	greater than 30	Area reclaim.
Coarse fragments (percent):[3]				
0 - 40 inches	less than 5	5 - 25	greater than 25	Small stones.
40 - 60 inches	less than 25	25 - 50	greater than 50	Area reclaim.
Salinity (mmhos/cm) (0 - 40 inches)	less than 4	4 - 8	greater than 8	Excess salt.
Layer thickness (inches)	greater than 40	20 - 40	less than 20	Thin layer.
Depth to high water table (feet)	---	---	less than 1	Wetness.
Sodium adsorption ratio (great group)	---	---	greater than 12 (halic, natric, alkali phases)	Excess sodium.
Soil reaction (pH) (0 - 40 inches)	---	---	less than 3.6	Too acid.
Slope (percent)	0 - 8	8 - 15	greater than 15	Slope.

---

[1] Based on Soil Conservation Service's definition of topsoil. (See table G-4.) Wyoming DEQ suitability differs in some areas from this table.

[2] Sum (100 - percent passing No. 10 sieve) and fraction greater than 3 inches. Use dominant condition for restrictive feature.

[3] If soil contains greater than 3 percent organic matter and has less than 35 percent clay, rate "good."

APPENDIX H

REVEGETATION COST ESTIMATES

This appendix summarizes independent reclamation authorities' and Wyoming DEQ's estimates of the costs to revegetate coal surface-mined lands. Table H-1 shows estimates from Tom Guobis (Native Plants, Inc., Salt Lake City, Utah; oral communication, May 1983) and Frank Munshower (Reclamation Research, Montana State University, Bozeman, Montana; oral communication, May 1983). The memorandum following this table gives revegetation cost estimates that Wyoming DEQ obtained from several different sources.

Table H-1.--Revegetation cost estimates

Data from Tom Guobis:

Plant big sagebrush containerized tubelings:
Tubelings - 57¢ in lots of 10,000 or greater
Planting - 60¢ to 75¢ per tubeling
Fertilizer - 8¢ per pellet per tubeling
Mycorrhizal inoculum - available and should be used for all big sagebrush revegetation efforts

Standard seed mix - \$75 to \$125 per acre

Surface manipulation:
Ripping - \$150 to \$200 per acre
Discing - \$20 to \$40 per acre
Harrowing - \$10 to \$15 per acre

Data from Frank Munshower:

Plant seed mix:
Seed mix - slightly less than \$100 per acre
Seedbed preparation - \$150 per acre or more, depending upon slope, mine soil, and planting requirements
Seeding - \$25 per acre

THE STATE OF WYOMING

ED HERSCHLER
GOVERNOR

Department of Environmental Quality

LAND QUALITY DIVISION

401 WEST 19TH STREET
TELEPHONE 307-777-7756
CHEYENNE, WYOMING 82002

MEMORANDUM

TO: Gary Beach - Supervisor, Review and Analysis

FROM: Patrick H. Boles, Plant Ecologist PHB

DATE: February 17, 1983

SUBJECTS: I. Phone Conversation's with Joe Coenenberg and Kim Carroll Concerning Costs of Shrub Tubelings, etc. on January 25, 1983

II. Cost of tubelings in relation to other reclamation costs

III. Some methods of improving shrub establishment from direct seeding

I. A. The following items were discussed with Joe Coenenberg of Northwestern Resources:

1. Cost of tubelings

- the Palouse Seed Company of Fairfield, Washington will supply tubelings of the following species for 0.64 cents/tubeling: big sagebrush, golden current, sumac, silver sagebrush, Wood's rose, and snowberry. Joe has furnished Palouse with seeds collected on site so that the tubelings will be adapted to local conditions.

- 250 tubelings can be planted per day by one individual earning a wage of $15.00/hour (union).

- a planting rate of 50-100 tubelings per acre has been used for big sagebrush. Joe estimated that the cost of such a rate would be "a couple of hundred dollars". He felt that a rate higher than this would not be economically feasible.

- example of costs: $0.64/tubeling x 75/acre = $48.
  $15/hr x *3.3 hrs. = $49.50
  * based on a planting rate of 250/8 hours
  total cost/acre: $97.50

2. Required reclamation goals in Montana

- presently there are no well defined goals for post-mining shrub density. Craig Howard of the Montana Dept. of State Lands is currently working on a shrub density standard (pers. comm.). I have supplied him with a copy of my paper on the subject ("Shrub Density and cover on Western Rangelands in Relation to Reclamation Standards for Coal Mined Lands in Wyoming", 27 p.).

3. Best time to plant tubelings

- fall dormant or early spring. Tubelings should not be planted past the middle of May.

4. Success with sumac

- I asked Joe if they have had any luck getting sumac established, since most of the operators who have tried it in the Powder River Basin have been successful.

- He tried seeding sumac a few years ago. The seed was first stratified in 90% sulfuric acid for 1 hour. The germination rate of the stratified seed was 60%. However, none of the sumac seedlings survived a two year drought which followed the seeding. Joe feels that during favorable years sumac could be established from seed. He has had good success with sumac establishment from tubelings and root stocks. A characteristic of sumac which makes it a desirable species to plant is its ability to spread vegetatively.

5. Tubelings Survival

- Silver sagebrush tubelings were sampled this past year and a survival rate of 100% was recorded.

- Big sagebrush tubelings have not been officially sampled yet but based on initial field observations he feels they will have a 95-99% survival rate.

B. The following items were discussed with Kim Carroll of Arco:

1. Cost of tubelings

- Arco will be transplanting approximately 14,000 tubelings this spring.

- cost/tubeling (includes on site seed collection, contract growing, delivery, and field planting): $1.21.

- additional costs, such as netting to protect the transplanted seedlings may raise the cost/tubeling to $1.65/plant. Other costs may include temporary holding facilities for the tubelings once they are delivered and any necessary irrigation.

- species that will be planted as tubelings: Wyoming big sagebrush, fringed sagebrush, silver sagebrush, rubber rabbitbrush, Wood's rose and skunkbush sumac. These species will be selectively placed in mosaic patterns.

2. Survival of transplants

- Kim feels that survival of the tubelings will only be around 30% based on results of similar plantings in the Powder River Basin.

- However, based on results at Colstrip survival rates should be higher if proper planting techniques are used and barring prolonged droughts.

II. Cost of tubelings in relation to other reclamation costs for bonding purposes (based on cost estimates presented in I.A.1. above).

Average mine in the Powder River Basin.

Permit Area: 6,000 acres
Affected Area: 4,500 acres

A. Reclamation Goal

(a) Case 1. 1 shrub/m2 on 4,500 acres (worst case)

= 1 x 4,047 = 4,047 shrubs/ac x 4,500 acres
= 18,211,500 tubelings x $0.64/tubeling
= $11,655,360

(b) Case 2. 1 shrub/m2 on 500 acres (more than 10% of area)

= 1 x 4,047 = 4,047 shrubs/ac x 500 acres
= 2,023.5 tubelings x $0.64/tubeling
= $1,295,040

(c) Case 3. 75 shrubs/ac (described as economically feasible; see I.A.1. above) on 4,500 ac (=0.02 shrub/ac).

= 75 shrubs/ac x 4,500 acres
= 337,500 tubelings x $0.64 acres
= $216,000

B. Tubelings in relation to other reclamation costs (estimates totalling 857.14/ac from Big Horn Coal, Amendment No. 1; tubeling costs from II.A. above).

Operation	Cost/ac
Scarify	$63.01
Disc	59.29
Harrow	35.54
Seed	101.93
Drill Seed	41.86
Fertilizer	29.50
Apply fertilizer	4.61
Mulch	280.00
Apply mulch	241.40
TOTAL:	$857.14
TUBELINGS (1/m2)	$2,590.00
LABOR	1,243.20
TUBELINGS (75/ac)	48.00
LABOR	23.04

(a) Due to the cost involved, tubelings will probably not be planted at rates higher than 100/acre (at least not on a large scale).

(b) Considering the cost tubelings should only be used in special plantings, e.g. around selected rock piles, drainageways, etc. and not as a means of meeting a shrub density goal such as 1 shrub/m2.

(c) Direct seeding appears to be the most economically feasible method of achieving reclamation goals for shrub density. In a study done on arid rangelands Monsen and Christiansen (1975) reported that rubber rabbitbrush, low rabbitbrush, fourwing saltbush, and big sagebrush were successfully established through direct seeding. The densities achieved ranged from 1.3/m2 (5,100/ac) to 3.5/m2 (14,000/ac) for rubber rabbitbrush, 0.17/m2 (700/ac) to 0.59/m2 (2,400/ac) for low rabbitbrush, 0.04/m2 (160/ac) to 0.4/m2 (1,900/ac) for big sagebrush, and 0.07/m2 (270/ac) to 0.17/m2 (680/ac) for fourwing saltbush.

(d) Seeding failures in the past can be attributed at least in part to:

(1) technique - drill seeding usually results in most shrub seeds being buried too deeply. An exception is fourwing saltbush which has relatively large seeds.

(2) Failure to use adapted seed sources.

(3) Seeding all species in a single operation. Shrub seedlings, as well as warm season grasses, cannot complete successfully with the more vigorous cool season grasses (Coenenberg, 1982).

III. Methods of increasing shrub establishment from direct seeding

1. Staggered seeding - consists of two phases (Coenenberg, 1982).

Phase 1: Shrubs, forbs, warm season grasses are broadcast seeded using a Brillion seeder (this insures that at least some seeds of the various species will be placed at an optimum depth for its germination).

Phase 2: This is implemented after one to two growing seasons. In this phase the seed of the more aggressive cool-season grasses are interseeded with a drill after the less competitive species have been given a chance to become established.

2. Collection of seed from the proposed mine site. This insures that only ecotypes which are adapted to local environmental conditions are used.

3. Mycorrhizal inoculation. Moorman and Reeves (1979) found that 77 percent of the plant species on undisturbed sites had mycorrhizae on their roots compared to only 2 percent on a nearby disturbed site. Mycorrhizal associations have been "shown to be the rule" rather than the exception in natural plant communities (Schenck, 1982). Mycorrhizae fungi is absent in topsoil which has been stored for long periods.

References

Coenenberg, J. 1982. Methods for Establishment of Diverse Native Plant Communities at the Rosebud Mine. Symposium on Surface Coal Mining and Reclamation in the Northern Great Plains, Bozeman. pp. B-6-1 to B-6-20.

Monsen, S. and D. Christiansen. 1975. Woody Plants for Rehabilitating Rangelands in the Intermountain Region. pp. 72-119. In: Wildland Shrubs, Symposium and Workshop Proceedings, Provo, Utah.

Moorman, T. and F. Reeves. 1979. The role of endomycorrhizae in revegetation practices in the semi-arid west. 11. A bioassay to determine the effects of land disturbance on endomycorrhizal populations. Am. J. Bot. 66:14-18.

Schenck, N. (editor). 1982. Methods and Principles of Mycorrhizal Research. The American Phytopathological Society, St. Paul, Minn. 244 p.

APPENDIX I

BLM PETITION RECOMMENDATION LETTER AND LETTER OF REVISION

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Wyoming State Office
P.O. Box 1828
Cheyenne, Wyoming 82001

IN REPLY
REFER TO:
1608/3400
(923-6)

FEB [illegible] 83

Mr. Allen D. Klein
Administrator
Western Technical Center
Office of Surface Mining
Reclamation and Enforcement
Brooks Towers
1020 15th Street
Denver, Colorado 80202

Dear Mr. Klein:

This is in response to your December 29, 1982, letter requesting our recommendation for approval or disapproval of the National/Wyoming Wildlife Federation petition for designating the proposed Red Rim coal lease tract as unsuitable for surface coal mining.

Recommendation

We recommend that the subject petition be disapproved. This recommendation is based upon the premises that:

1. The petitioners have presented no new evidence that was not considered in reaching our final land use planning decision for the proposed Red Rim coal lease tract, and

2. The current general and specific land use planning decisions relevant to the tract and the resulting stipulations to be included in any coal lease issued provide sufficient protection and mitigation to negate the concerns and allegations of the petition.

Discussion

The principle issues concerning the Red Rim tract since early 1979 have centered around (1) application of coal unsuitability criterion #15 (43 CFR 3461.1(o)) in identifying the "most critical" antelope winter range and the significance of adverse affects of surface coal mining operations within said habitat upon the antelope within the Baggs Herd Unit and (2) feasibility of reclaiming the vegetation and, most pertinently, the topographic features of the habitat, if it were to be surface mined.

While the petition basically reiterates these principle issues, it is apparent that the petitioners are unaware of the extent to which their concerns and allegations have been accommodated by our land use planning decisions and stipulations that would be imposed upon any Federal coal lease issued for the tract. In view of these decisions and stipulations, we consider the petitioners' intent to have any part or all of the Red Rim tract formally designated as unsuitable for surface mining operations to be unwarranted. We also consider such action to be inconsistent with our mandate to plan and manage the Federal lands and resources on the bases of multiple use, sustained yield, and environmental integrity. This is particularly true since compliance with the mandate is readily reflected in the mentioned decisions and stipulations. Perhaps the petition is a reflection of the fact that the stipulations for the proposed lease tract have been in development and have had no public distribution. We offer the following as further support to the above rationale and to our recommendation for disapproval of the petition.

1. No Surface Occupancy Stipulations:

By my memorandum of May 21, 1982, to the Director, BLM, it was decided that a portion of the Red Rim tract will be stipulated for no surface occupancy for the protection of critical antelope winter range. The area involved is shown on the attached map (enclosure 1) and described below:

T. 20 N., R. 89 W., 6th P.M.
  Sec 8: N½SW¼
  Sec 18: Lot 4, E½NE¼, SE¼

T. 20 N., R. 90 W., 6th P.M.
  Sec 24: E½NE¼, S½SW¼, SE¼
  Sec 26: E½E½, S½SW¼, SW½SE¼
  Sec 34: E½NE¼, S½SW¼, SE¼

T. 19 N., R. 90 W., 6th P.M.
  Sec 4: SE¼NE¼, NE¼SW¼, S½SW¼
  Sec 8: NE¼, N½SE¼

a. Through our deliberations with the Governor of Wyoming, including direct participation of the Wyoming Game and Fish Department, the area covered by this stipulation was determined to be the most critical antelope winter range area in relation to the Red Rim tract. Within the tract the stipulated area provides total protection for the most significant habitat features of topography, drainage, and vegetation patterns that are emphasized in the petition, as well as an antelope migration route through the area. Thus, reclaimability and mining impacts of the stipulated area are not at issue.

b. It is well to point out that from the location of the easternmost minable coal seam shown on the map the most critical antelope winter range within the Red Rim tract has never been in jeopardy of being physically surface mined. The no surface occupancy stipulation is to be imposed to further protect the antelope and habitat values from the impacts and other disturbances associated with location, construction, and operation of surface ancillary mining facilities.

c. The map may be a little misleading on two points.

(1) The BLM management authorities do not extend to the intermingled coal lands in private ownership as the map may appear to imply (i.e., concerning the no surface occupancy area).

(2) The map does not depict the total area of critical antelope winter range that is actually involved and that we considered. There are other portions of the habitat in the immediate vicinity of and adjacent to the Red Rim tract (i.e., offsite) that would be unaffected by leasing and mining the tract.

d. In addition, the areas described below (also a part of the antelope habitat) will be stipulated for no surface occupancy for protection of an eagle nest/buffer zone and riparian habitat buffer along Separation Creek:

T. 20 N., R. 89 W., 6th P.M.
Sec 4: SE¼SW¼SW¼, SE¼SW¼

T. 19 N., R. 90 W., 6th P.M.
Sec 8: NW¼NE¼
Sec 6 and 8: ¼ mile either side of the centerline along Separation Creek where it crosses Federal lands.

2. We have provided a copy of the detailed antelope habitat mitigation stipulation we have developed (enclosure 2) to display the degree of emphasis and stringency to be afforded to mitigation of antelope habitat impacts in the entire area of the tract. The lessee would be required to develop the mitigation plan in conjunction with the mine and reclamation plan and its approval would be part of the mine plan approval and permitting process. We consider this stipulation more than adequate to negate the petitioners' concerns in the remaining, less significant area of the tract (i.e., the area outside the areas stipulated for no surface occupancy.)

3. Other Considerations

Some of the provisions of the petitioning process appear to place some degree of emphasis upon the economics of the mining operation and the economics of reclamation in determining whether or not a given area is formally designated as unsuitable for surface mining operations. We suggest that these factors should have no bearing on such a decision. Rather, the formal unsuitability designation should be based upon the factors of (1) technological capability to mine and to reclaim a given area, (2) properly formulated land use plans which have utilized extensive public input, environmental, social, and economic considerations in deciding whether or not an area should be allocated to coal development, and (3) the "required" conditions, "only under which" the mining would be allowed.

In considering the above with specific regard to the Red Rim Tract--

a. Economics of mining are part of the criteria used in determining that the coal resource in the tract has development potential. This potential still exists after considering the surface mining unsuitability, other multiple use value, and environmental conflict factors. We maintain that the technical capabilities to surface mine and reclaim the tract in an environmentally sound manner have been adequately addressed, supported, and demonstrated by past and current operations and methodologies.

b. The costs of either mining or reclaiming the tract are interrelated and interdependent. One will affect and may dictate the other. The period of time over which these actions will be accomplished is also a factor of their costs. In addition, what may be uneconomical today may be economical in the future as technology, methodology, demands, etc., improve or change. It remains a fact that the required conditions, only under which mining of the tract would be allowed, must be met. These requirements are a given and will be known before the tract would be offered for lease. Thus, we believe the economic feasibility of mining and reclaiming the tract become the concern of industry and will be reflected in (1) whether or not bids will be submitted for a lease, and (2) if leased, whether or not an approved mine plan and permit will be obtained, and (3) if obtained, whether or not the tract will actually be mined.

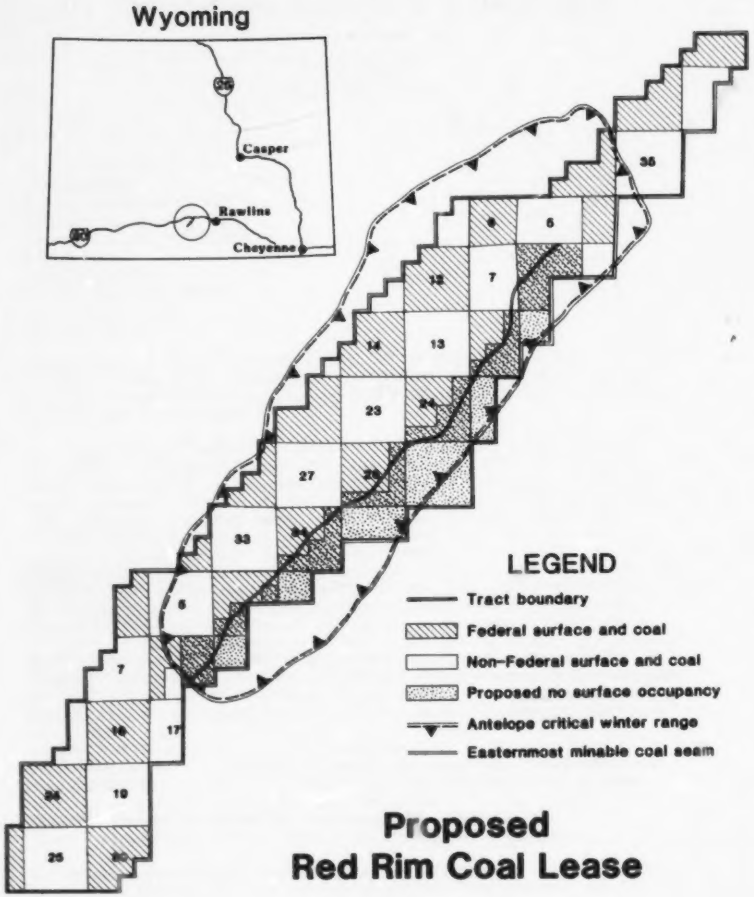
Conclusion

In considering the two antelope habitat stipulations and the other information presented above, we can find no reasonable justification for a formal unsuitability designation on any portion of the Federal coal lands within the proposed Red Rim coal lease tract. We urge you to contact us for any additional information or details you may need in determining approval or disapproval of the subject petition.

Sincerely yours,

Maxwell T. Lieurance
State Director

Enclosures


Wyoming
Casper
Rawlins
Cheyenne
35
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8
7
12
13
14
23
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26
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5
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LEGEND
Tract boundary
▨ Federal surface and coal
☐ Non-Federal surface and coal
▒ Proposed no surface occupancy
Antelope critical winter range
Easternmost minable coal seam
Proposed
Red Rim Coal Lease

Enclosure 1

Antelope Habitat Mitigation
Stipulation for Red Rim Tract

The lessee shall be required to mitigate for antelope habitat loss where applicable and the resultant loss or displacement of this species as a result of surface coal mining operations. The lessee shall be required to submit for approval to the Authorized Officer and the State of Wyoming a habitat recovery and replacement plan for protection or enhancement of antelope populations affected by habitat loss or displacement from historical habitat.

The habitat recovery and replacement plan shall be developed in consultation with the Authorized Officer and the State of Wyoming. It will be based on estimates of lost and disturbed habitat as described in the Green River-Hams Fork Final Regional Coal Environmental Impact Statement. If the mine plan submitted by the lessee indicates figures different from those in the final environmental impact statement as to quality and quantity of habitat lost or disturbed, mitigation alternatives shall be recalculated based on revised data contained in the mine plan.

The final habitat recovery and replacement plan shall indicate the methods to be employed by the lessee, which will ensure that the carrying capacity of the recovered or replaced land has the capacity to support the species as agreed on by the Authorized Officer and the State of Wyoming.

Mitigation methods may require the lessee to employ techniques for wildlife range manipulation, intensive wildlife management, or intensified rehabilitation. Habitat recovery may not be completely feasible in the permit area, therefore, recovery or replacement may be accomplished on lands made available through the surface management agency, the State, or the lessee outside the permit area in combination with recovery and replacement methods on suitable lands within the permit area.

The habitat recovery and replacement plan shall include the following:

1. A habitat analysis of the permit area which:

a. Identifies the antelope populations that occupy the permit area, and

b. Includes an analysis of the quality carrying capacity of the habitat for those species.

2. A detailed description of the methods selected by the lessee to mitigate habitat loss, together with a comparative analysis of alternative methods which were considered and rejected by the lessee, and the rationale for the decision to select the proposed methods. The methods utilized by the lessee for recovery and replacement may include, but are not limited to, the following techniques:

Enclosure 2

a. Increasing the quantity and quality of forage available to wildlife.

b. The acquisition of critical wildlife habitats.

c. Mechanical manipulation of low quality wildlife habitat to increase its carrying capacity for selected wildlife species.

3. A timetable giving the periods of time which will be required to accomplish the habitat recovery or replacement plan and showing how the timetable relates to the overall mining plan.

4. An evaluation of the final plan by the State of Wyoming. The State shall comment on the methods selected and the techniques to be employed by the lessee and may recommend alternate recovery or replacement methods. If the State has recommended an alternate method, the lessee shall consider the State's recommendation and if the lessee rejects the State's plan, the lessee shall indicate its reasons as required by provision 2 above. If no State comment is included in the plan, the lessee shall verify its consultation with the State and the plan may be considered without State comment.

United States Department of the Interior
BUREAU OF LAND MANAGEMENT
Wyoming State Office
P.O. Box 1828
Cheyenne, Wyoming 82003

IN REPLY REFER TO
1608 (924)
3400

AUG 22 1983

Mr. Allen D. Klein
Administrator
Western Technical Center
Office of Surface Mining
Reclamation and Enforcement
Brooks Towers
1020 15th Street
Denver, Colorado 80202

Dear Mr. Klein:

In the August 10-11 meeting concerning the Red Rim coal unsuitability petition effort, a few concerns were identified that need clarification. This is to confirm the verbal clarification my staff provided to Messrs. Albrecht and Winterringer.

1. Regarding my February 7, 1983, letter to you--the citation of the described no-surface-occupancy area from my May 21, 1982, memorandum to the Director, Bureau of Land Management (BLM), as a decision is semantically incorrect. The May 21, 1982, memorandum amends an October 6, 1981, decision referenced below. Inadvertently through a technical oversight the formal Federal Register notification of this amended decision was not conducted and, therefore, must be considered technically a recommendation. This should not diminish the intent that the recommended no-surface-occupancy area should not be linked to the less well defined area (easternmost mineable coal seam) described in the October 6, 1981, memorandum.

My October 6, 1981, memorandum to the Director includes a no-surface-occupancy stipulation, for the same general area mentioned above, described by metes and bounds. This stipulation is a decision derived through BLM planning and environmental analysis efforts on the Red Rim tract/area and direct consultation with the Governor of Wyoming. It should be understood that if a Federal coal lease for the Red Rim tract were to be issued today, this no-surface-occupancy area would be a stipulated condition of the lease. It should be further understood that in doing this the area would be described by legal subdivision, no smaller than 10-acre aliquots to approximate the metes and bounds description as closely as possible.

2. Regarding the Rawlins BLM District Manager's May 5, 1983, memorandum to me--that memorandum transmits the mitigation "requirements" for the proposed Red Rim coal lease tract that BLM has identified to date. The timing of this compilation was specifically to facilitate the Red Rim petition evaluation. As with (and including) the October 6, 1981, no-surface-occupancy stipulation, these requirements were derived through the statutory regulatory and procedural requirements of the Federal Coal Management Program that BLM must conduct to determine areas that are acceptable for further consideration for coal leasing. These requirements are more than mere proposals. Again, if a coal lease were issued for the Red Rim tract today, mitigation requirements 1-5 and 9-12 would be stipulated conditions of the lease. The remote possibility that any of these items would change or not be lease stipulations would only result from new data or field conditions that would justify such action.

Mitigation requirements 6-8 and 13-17 would not be lease conditions because they are among those "postlease" considerations and requirements under authority of your agency and the State regulatory agency in the course of mine plan approval and permitting. These items are, nonetheless, specifically pertinent to the Red Rim tract and known postlease requirements.

In view of the above, we strongly advise that all of the identified mitigation requirements are part of any proposed coal development for the Red Rim tract. They should be included as givens or assumptions in all development alternatives being analyzed in the Red Rim PED/EIS document.

If you have any questions on these matters, please contact Joe Patti, Coal Planning Coordinator, at FTS 328-2571.

Sincerely yours,

Maxwell T. Lieurance

Maxwell T. Lieurance
State Director

APPENDIX J

BLM CURRENT MITIGATION REQUIREMENTS FOR PROPOSED RED RIM COAL LEASE TRACT W-73097

UNITED STATES GOVERNMENT
Memorandum

DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

IN REPLY REFER TO:
3420
W-73097

Date: [illegible] 1983

To : State Director, Wyoming (924)

From : District Manager, Rawlins

Subject : Mitigation Requirements for the Proposed Red Rim Coal Lease Tract

Enclosed are the current mitigation requirements for the proposed Red Rim tract. These include standard coal lease stipulations, as well as additional mitigation measures identified during the planning and environmental evaluation of this tract. If this tract is leased in the future, some of these additional mitigation measures will be reflected as special lease stipulations, while some will be required through state and federal mine permitting programs.

Portions of the mitigation measures may need to be refined or modified as a result of OSM/DEQ unsuitability petition review, or as additional physical data is gathered on the tract.

1 Enclosure
Encl. 1 - Mitigation Requirements

May 1983

MITIGATION REQUIREMENTS
FOR
PROPOSED RED RIM COAL LEASE TRACT

1. CULTRUAL RESOURCES

a. Before undertaking any activities that may disturb the surface of the leased lands, the lessee shall conduct a cultural resource intensive field inventory in a manner specified by the authorized officer of the Bureau of Land Management (BLM) on portions of the mine plan area and adjacent areas, or exploration plan area (including privately owned surface with the consent of the landowner), that may be adversely affected by surface disturbing activities and which have not been previously inventoried at such a level of intensity. The inventory shall be conducted by a qualified professional cultural resource specialist with a current federal antiquitie permit, and a report of the inventory and recommendations for protecting any cultural resources identified shall be submitted to the Regional Director of the Office of Surface Mining and the authorized officer of BLM. The lessee shall undertake measures, in accordance with instructions from the Regional Director, to protect cultural resources on the leased land. The lessee shall not commence the surface disturbing activities until permission to proceed is given by the Regional Director (or BLM if activities are associated with coal exploration outside an approved mining permit area). During May 1977, a cultural resource sample inventory was conducted of the proposed Red Rim Coal lease area. The results of that inventory indicate a high site density potential for the area, and the report recommends an intensive cultural resource survey of the remaining uninventoried lands within the lease boundary.

b. The lessee shall protect all cultural resource properties within the lease area from surface disturbing activities until the cultural resource mitigation measures can be implemented as part of an approved mining and reclamation plan or exploration plan. A mitigation plan will be submitted to the authorized officer and Regional Director for approval. This mitigation plan will be prepared in accordance with the Advisory Council on Historic Preservations Handbook for Treatment of Archeological properties.

c. The cost of conducting the inventory, preparing reports, and carrying out mitigation measures shall be borne by the lessee.

d. If cultural resources are discovered during operations under a lease, the lessee shall immediately bring them to the attention of the Regional Director (or BLM if activities are associated with coal exploration outside an approved mining permit area). The lessee shall not disturb such resources except as may be subsequently authorized by the Regional Director (or BLM if activities are associated with coal exploration outside an approved mining permit area). Within two (2) working days of notification, the Regional Director (or BLM if activities are associated with coal exploration outside an approved

Enclosure 1

mining permit area) will evaluate or have evaluated any cultural resources discovered and will determine if any action may be required to protect or preserve such discoveries. The cost of data recovery for cultural resources discovered during lease operations shall be borne by the surface managing agency (if different).

e. All cultural resources shall remain under the jurisdiction of the United States until ownership is determined under applicable law.

2. PALEONTOLOGICAL RESOURCES

a. Before undertaking any activities that may disturb the surface of any leased lands, the lessee shall contact BLM to determine whether the authorized officer will require the lessee to conduct a paleontological appraisal of the mine plan and adjacent areas, or exploration plan areas, which may be adversely affected by lease-related activities. If the authorized officer determines that one is necessary, the paleontological appraisal shall be conducted by a qualified paleontologist approved by the authorized officer of the surface managing agency (BLM if the surface is privately owned), using the published literature and, where appropriate, field appraisals for determining the possible existence of larger and more conspicuous fossils of scientific significance. A report of the appraisal and recommendations for protecting any larger and more conspicuous fossils of significant scientific interest on any leased lands so identified shall be submitted to the authorized officer of the surface managing agency (BLM if the surface is privately owned). When necessary to protect and collect the larger and more conspicuous fossils of significant scientific interest on any leased lands, the lessee shall undertake the measures provided in the approval of the mining and reclamation plan or exploration plan.

b. The lessee shall immediately bring any such fossils that might be altered or destroyed by his operation to the attention of the Regional Director or BLM as appropriate. Operations may continue as long as the fossil specimen or speciments will not be seriously damaged or destroyed by the activity. The Regional Director or BLM as appropriate, shall evaluate or have evaluated such discoveries brought to his attention and, within five (5) working days, shall notify the lessee what action shall be taken with respect to such discoveries. The cost of any required salvage of such fossils shall be borne by the United States.

c. All such fossils of significant scientific interest shall remain under the jurisdiction of the United States until ownership is determined under applicable law. Copies of all paleontological resource data generated as a result of any lease term requirements will be provided to the Regional Director of BLM as appropriate.

d. These conditions apply to all such fossils of significant scientific interest discovered within any lease area whether discovered in the overburden or coal seam(s).

3. The lessee will protect all survey monuments, witness corners, reference monuments, and bearing trees against destruction, obliteration, or damage during operations on the lease area. If any monuments, corners, or accessories are destroyed, obliterated, or damaged by this operation, the lessee will hire an appropriate county surveyor or registered land surveyor to reestablish or restore the monuments, corners, or accessories at the same location, using surveying procedures in accordance with the "Manual of Surveying Instructions for the Survey of the Public Lands of the United States," and will record the survey in the appropriate county records, with a copy sent to the authorized officer.

4. The lessee shall comply with all valid and applicable laws and regulations of federal, state, and local governmental authority.

5. This lease is issued subject to valid existing rights.

6. The lessee shall return the surface of the leased lands to native range for livestock grazing, wildlife habitat and public recreation. Reclaimed areas will be protected to exclude livestock and big game animals until new vegetation is established to the satisfaction of the authorized officer. If protective fencing is found to significantly inhibit pronghorn movements on the winter range, alternative exclusion methods may be required.

7. As determined by the authorized officer, the lessee shall develop new, reliable water sources and facilities to replace existing water sources and facilities on public lands disturbed or destroyed by mining.

8. Range improvements on the leased lands shall not be disturbed without prior written permission of the authorized officer. As determined by the authorized officer, range improvements which are disturbed by the lessee shall be replaced as soon as practicable.

9. In order to protect riparian zones and water quality, no surface occupancy will be allowed within 1/4 mile of either side of Separation Creek on the federal coal lands within the areas described below. Any exceptions for support facilities such as telephone lines, power lines, etc. may be allowed only with prior written permission of the authorized officer.

T. 20 N., R. 90W., 6th P.M.
    Sec. 28: SE¼SW¼,
    Sec. 32: SW¼SE¼, NE¼SE¼

T. 19 N., R. 90W., 6th P.M.
    Sec. 6: Lot 1, SE¼NE¼, E½SE¼,
    Sec. 8: NW¼W½SW¼

In addition, during the coal unsuitability review for the proposed Red Rim Tract area, the Separation Creek drainage, which passes through and near the tract was identified as a possible alluvial valley floor (AVF) area (coal unsutiability criterion number 19). This possible AVF area is generally contained within the riparian zone identified above. AVF determinations are usually made by the Office of Surface Mining (OSM) and the state of Wyoming at the time of mine plan approval and permitting. Any surface coal mining operations within the tract that could interrupt or intercept waterflow to these areas may only be conducted subject to mitigation measures for AVF and riparian zone protection that are made a part of an approved mine plan.

10. In order to protect existing eagle nests and their associated buffer zones (i.e., pertinent to application of coal unsuitability criterion number 11), no surface coal mining operations will be allowed on such lands. Any exception (if granted) for support facilities (e.g., telephone lines, powerlines, etc.) will require that no surface disturbing activities are to take place in such areas during the nesting season. In addition, such exceptions will be subject to restrictive placement and type or design of facilities, seasonal occupancy, etc. and may be allowed only with prior written permission of the authorized officer. The lands generally described below contain the buffer zone areas for eagle nests known to exist at this time. Since these and other bird species (i.e., pertinent to coal unsuitability criteria numbers 11, 12, 13, and 14) may move onto, off of, or elsewhere in the lease area, their activities must be monitoried to determine changing protection requirements.

T. 20N., R. 89W., 6th P.M.
Sec. 4: SE¼SW¼SW¼, SE¼SW¼

T. 19N., R. 90W., 6th P.M.
Sec. 8: NW¼SE¼, NE¼4NW¼

11. The lessee shall be required to mitigate for wildlife habitat loss where applicable and the resultant loss or displacement of wildlife habitat or displacement of wildlife species as a result of surface coal mining operations. The lessee shall be required to submit for approval to the authorized officer and the State of Wyoming a habitat recovery and replacement plan for protection or enhancement of wildlife populations affected by habitat loss or displacement from historical habitat. Through consultation with the State of Wyoming (coal unsuitability criterion number 15), antelope winter habitat was of significant concern. Through consultation with the U.S. Fish and Wildlife Service (coal unsuitability criterion number 14), ferruginous hawk nesting habitat was of some concern.

The habitat recovery and replacement plan shall be developed in consultation with the authorized officer and the State of Wyoming. It will be based on estimates of lost and disturbed habitat as described in the Green River/Hams Fork Final Regional Coal Environmental Impact Statement (BLM, 1981), and other related documents. If the mine plan submitted by the lessee indicates figures different from those in the final environmental impact statement as to quality and quantity of habitat lost or disturbed, mitigation alternatives shall be recalculated, based on revised data contained in the mine plan.

The final habitat recovery and replacement plan shall indicate the methods to be employed by the lessee, which will ensure that the vegetative composition, structure and production of the recovered or replaced land has the capacity to support the wildlife communities as agreed on by the authorized officer and the State of Wyoming.

Mitigation methods may require the lessee to employ techniques for wildlife range manipulation, intensive wildlife management, or intensified rehabilitation. Habitat recovery may not be completely feasible in the lease area; therefore, recovery or replacement may be accomplished on lands made available through the surface management agency, the state, or the lessee outside the lease area in combination with recovery and replacement methods on suitable lands within the lease area.

The habitat recovery and replacement plan shall include, but is not limited to the following:

a. A habitat analysis of the lease area which:

   (1) Identifies the significant antelope and ferruginous hawk populations that occupy the area.

   (2) Includes an analysis of the vegetative composition, structure, and production, and cover of the habitat for these species and other game and nongame species associated with these habitats.

   (3) Identifies topographic features necessary for the impacted species (i.e. windblown slopes for pronghorn critical winter range, suitable nesting structures for ferruginous hawks).

b. A detailed description of the methods selected by the lessee to mitigate habitat loss, together with a comparative analysis of alternative methods, which were considered and rejected by the lessee, and the rationale for the decision to select the proposed methods. The methods utilized by the lessee for recovery and replacement may include, but are not limited to, the following techniques:

   (1) Increasing the quantity and quality of available forage to wildlife.

   (2) Mitigate other related offsite conflicts (fence modification, road closures, purchase of AUM's) within the herd unit.

   (3) The acquisition of critical wildlife habitats.

   (4) Mechanical manipulation of wildlife habitat to alter its successional stage for selected wildlife species.

c. A timetable giving the periods of time that will be required to accomplish the habitat recovery or replacement plan and showing how the timetable relates to the overall mining plan.

d. An evaluation of the final plan by the State of Wyoming. The state shall comment on the methods selected and the techniques to be employed by the lessee and may recommend alternate recovery or replacement methods. If the state has recommended an alternate method, the lessee shall consider the state's recommendation and if the lessee rejects the state's plan, the lessee shall indicate its reasons as required by provision 2 above. If no state comment is included in the plan, the lessee shall verify its consultation with the state and the plan may be considered without state comment.

e. Mitigation measures for threatened or endangered species (if any are identified on the lease area) are to be developed in consultation with the Fish and Wildlife Service and BLM.

f. In order to provide both a migration corridor and an intact unit of critical winter habitat for antelope within the Red Rim Tract, no surface occupancy will be allowed on those federal coal lands that lie from any point 500' S. E. of the easternmost minable coal seam to the east boundary of the tract. NOTE: Prior to offering a lease on this tract, this no surface occupancy area may be further adjusted or refined, due to on-going studies, and will be more specifically described.

12. Potential black-footed ferret habitat areas (prairie dog colonies) are known to exist on and near the lease area. The lessee will conduct an inventory to identify any additional potential ferret habitat. For any potential ferret habitat identified, the lessee will conduct black-footed ferret inventories in accordance with the guidelines below. In the event that ferret occurrence is identified on lands to be affected by mining-related activities, the lessee will be required to adhere to any suggested modifications in the mining operation provided by the Fish and Wildlife Service and BLM.

Black-Footed Ferret Inventory Guidelines:

> Proposed developments such as coal lease lands, power plant sites, well fields, dam sites, and other major, block-type developments shall be surveyed for prairie dogs before the project is approved. If prairie dogs are found on the proposed site, colonies will be mapped on topographic maps and each colony surveyed using recommended black-footed ferret survey procedures. Ferret searches will be scheduled as close to actual construction as is reasonable to minimize the possibility of missing ferrets that may move onto the area during the period between completion of surveys and the start of construction. Where project disturbance takes place over a long period of time, such as on a coal site, additional surveys for black-footed ferrets are recommended.

13. To minimize vehicle hazards from blowing dust and to reduce adverse visual impacts, no surface mining operations will be allowed on those federal coal lands in the lease area within T. 21N., R. 89W., sections 24 and 26 that lie between the Union Pacific Railroad and Interstate Highway 80.

14. The lessee shall make every reasonable effort to avoid or where avoidance is impracticable, minimize dust problems. BLM may require sprinkling, oiling, or other means of dust control on roads, trails, etc. The lessee shall conduct processing so as to prevent, or if prevention is impossible, minimize to the maximum extent possible, environmental or health problems associated with dust.

15. Generally, reclamation of disturbed lands will be accomplished as contemporaneously with mining activities as possible. The lessee shall recontour disturbed lands to approach the original topographic relief. Broken topography which significantly affects micro-habitats shall be an integral part of the recontouring effort. Reclamation techniques shall be utilized which will provide the requirements for diverse and reproducing native vegetation. Revegetation efforts shall be directed to approach the original species composition, structure, production and cover.

16. Overburden stockpiles shall be located so as to avoid or minimize damage to the surrounding lands.

a. Topsoil. The lessee shall remove the topsoil from the land in a separate layer, replace it on the backfill area, or if not utilized immediately, segregate it in a separate pile from other spoil and, when the topsoil is not replaced on a backfill area within a time short enough to avoid deterioration of the topsoil, maintain a successful cover by quick growing plants or other means thereafter so that the topsoil is preserved from wind and water erosion, remains free of any contamination by other acid or toxic material and is in a usable condition for sustaining vegetation when restored during reclamation. However, if topsoil is of insufficient quantity or of poor quality for sustaining vegetation, or if other strata can be shown to be more suitable for vegetation requirements, then the lessee shall remove, segregate, and preserve in a like manner such other strata which is best able to support vegetation. For the purpose of this section, topsoil is defined as the top horizon of overburden containing fertile soil or soil material, usually rich in organic matter and capable of sustaining plant growth and recognized as such by standard authorities.

b. Subsoil. The lessee shall, in accordance with these stipulations, either stockpile subsoil stripped from excavated areas for later reclamation of the areas, or place it on an available fill surface. For the purpose of this section, subsoil is defined as all overburden except topsoil.

17. The lessee shall prepare and submit, concurrently with the filing of its mine plan, a socioeconomic and transportation impact mitigation study concerning off-site aspects of the proposed development. At a minimum, this study shall adress and include a factual statement of the items outlined below.

a. The estimated number of employees the specific lease operation will require during its phases of construction and operation, the estimated multiplied population attendant to the employment, and where that population is anticipated to reside.

b. An analysis of the estimated effect of that population influx on the county and community infrastructure based on information acquired in consultation with state and local government and including:

(1) Transportation system at the county and local level.

(2) The domestic water requirements.

(3) The domestic sewage treatment facilities and collection system requirements.

(4) The requirements on the education facilities.

(5) The requirements the new population would impose on the fire and police protection systems.

(6) The requirements that the additional population would make on local government service systems, with primary emphasis on the normal public works of both county and municipal governments.

(7) The requirements on the human service system.

(8) The requirements imposed on the parks and recreation system.

(9) An estimate as to the need, by type, and amount of housing that the new population would require on a community by community basis.

c. A statement of the immediate impacts and long-term effects of mining on transportation facilities within the states, including:

(1) The estimated transportation mode(s), route(s), and frequency of trips for the extracted resource.

(2) Contimplated construction of transportation facilities.

(3) The estimated effect of any truck movements on the rate of roadway pavement deterioration, on the design life of the transportation mode, on the level of service repair, and on overall safety to the motoring public.

(4) A discussion of those measures that would or could mitigate impacts on those transportation modes such as proper signing, lighting, and design or access to and from public roadway(s).

d. A statement of the perceived roles and responsibilities of the lessee, the affected local governments, and the State of Wyoming, relating to the technical and financial needs of the affected communities.

APPENDIX K

BLM POSTMINING LAND USES AND RECLAMATION REQUIREMENTS FOR THE PROPOSED RED RIM COAL LEASE TRACT

United States Department of the Interior

Bureau of Land Management
Wyoming State Office
P.O. Box 1828
Cheyenne, Wyoming 82003

IN REPLY REFER TO:
3400 (924,
930) Red Rim

Mr. Allen D. Klein, Administrator
Western Technical Center
Office of Surface Mining
Reclamation and Enforcement
Brooks Towers
1020 15th Street
Denver, Colorado 80202

Dear Mr. Klein:

This is in response to Mr. Schilling's request for the Bureau of Land Management (BLM) to identify the post mining land uses and quantified reclamation requirements for the Red Rim coal tract. We understand the purpose of this information is to help you develop the conclusions on the Red Rim Petition Evaluation Document/Environmental Impact Statement (PED/EIS).

As emphasized in the attached submission, the extent to which we can satisfy your request at this point is in terms of foreseeable, long range goals and objectives. This may not present the level of specificity, detail, and quantification ultimately needed, since much of it is highly dependent upon a detailed studies and plans that would have to be developed in conjunction with a mine plan.

Sincerely yours,

Hillary A. Oden

Hillary A. Oden
State Director

Enclosure

Post Mining Land Uses and Reclamation Requirements For The Proposed Red Rim Coal Lease Tract

The most important basic reclamation requirements for the Red Rim Tract, in priority order, are reestablishment of: (1) the broken topography features; (2) sufficient vegetative ground cover to stabilize disturbed land areas from erosion; and (3) an ultimate vegetative ground cover and species composition that will approach premined conditions. These would be directed toward adequately reclaiming the critical antelope winter range, consistent with the Wyoming Game and Fish Department (WGFD) population management objective for the Baggs Antelope Herd Unit. The primary post mining land uses being wildlife, livestock grazing, and recreation.

The remainder of this submission addresses only items 2 and 3 above. The reestablishment of topographic relief essentially concerns existing engineering technology and, otherwise, is somewhat dependent upon the vegetation and habitat conditions to be effected.

A vegetation study conducted by Rocky Mountain Energy Company (RME) during the 1980 growing seasons, contains the most current and comprehensive vegetation data for the Red Rim coal tracts. Eight vegetation types were defined and delineated within the study area: sagebrush, sage-grass, saltbush, riparian, mountain shrub, grassland, greasewood, and meadow. Each type was intensively sampled for shrub cover, density, height, vigor, and herbage production. The study also identified distribution and juxtaposition of these vegetation types.

The relative abundance, distribution, and juxtaposition of these vegetation types will need to be decided during the development of the Habitat Recovery and Replacement Plan (HRRP) after a site specific mine plan has been developed. Several of these vegetation communities stand out as being more important than others. The sage-grass community interspersed with tall sagebrush and grassland communities have features which are most important for a critical antelope winter range. The riparian and mountain shrub communities have a high value for maintaining species diversity within the area. These two communities generally lay outside of the coal tract.

Table I summarizes mean annual grass and forb herbage production and lists some of the major grass species by vegatation type. Production is presented in lbs/acre of oven dry material. The riparian type showed the maximum production with 1,557 lbs/acre; the saltbush type had the lowest production with approximately 87 lbs/acre. Grasses were the major lifeform contributing to the herbage production in all vegetation types.

Table 2 presents a summary of mean percent canopy cover and individual plant density for shrub species in the various vegetation types. The most valuable shrubs are "starred." The sage vegetation type had the highest shrub cover with 27.14 percent cover. The lowest shrub cover was indicated by the saltbush vegetation type with only 7.9 percent cover. Shrub density was highest in the saltbush type with 16,266 individuals per acre. It was lowest in the mountain shrub type with 6,381 shrubs per acre.

Table 3 displays a summary of mean percent canopy cover for half-shrub species. Winterfat, Ceratoides lanata, is considered the most important half-shrub occurring in the vegetation types.

Long range reclamation goals and objectives for the Red Rim coal tract would be to reestablish or approach reestablishment of premined vegetation conditions and would include the following:

1. Reestablish a critical antelope winter range which provides the features necessary to support the premining population objective for the Baggs antelope herd in the long term. Examples of these features include, but are not limited to, windblown sage-grass vegetation communities interspersed with tall sage and grassland communities.

2. Reestablish the production of grass and forbs in all vegetation types within 10% of the premined mean indicated in Table I. The majority of grass production will include the grass species indicated in the particular vegetation type. Forb species would be determined during the development of the HRRP.

3. Reestablish the percent canopy cover for each "starred" shrub in each vegetation type or the density of each "starred" shrub in each vegetation type, within 10% of the premined mean indicated in Table II. The remainder of the shrub species and their density or canopy cover should be considered in developing the HRRP.

4. Reestablish the canopy cover for Ceratoides lanata in the sage-grass, saltbush, and grassland vegetation communities. Other half-shrub species and the occurrence of winterfat in other vegetation types should be considered in the development of the HRRP.

These are long range goals and objectives for attaining ultimate vegetative reclamation of the Red Rim coal tract, if it were to be leased and mined. The first priority toward attaining vegetative reclamation is to "stabilize" the areas disturbed by mining and related activities against erosion, with an adequate ground cover of vegetative species that will grow and establish in such mediums. The initial and early stages of reclamation may vary from the long range goals and premined conditions. The direction of early vegetative reclamation should be toward creating site specific and micro/macro surface climatic conditions that will allow either natural plan succession and/or seeding/transplanting of desired species. The details of these various requirements should all be considerations in mine plan approvals and enforcement of mining and reclamation operations.

TABLE I
Summary of Mean Annual Grass and Forb Herbage Production

Vegetation Type and Grass/Grass like Species	Oven Dry Weight (lbs/acre)
Sage	
Grass	157.2
Western wheatgrass (*Agropyron smithii*)	
Canby bluegrass (*Poa canbyi*)	
Fendler bluegrass (*Poa fendleriana*)	
Squirreltail (*Sitanion sp.*)	
Needle and thread (*Stipa sp.*)	
Indian ricegrass (*Oryzopsis hymenoides*)	
Forb	81.3
Total	238.5
Sage-grass	
Grass	176.8
bluegrass, Indian ricegrass, needle and thread, western wheatgrass	
Forb	25.0
Total	201.8
Saltbush	
Grass	79.5
Squirreltail, western wheatgrass, canby's bluegrass, Indian ricegrass	
Forb	7.1
Total	86.6
Riparian	
Grass/grasslike	1032.3
Pacific giant wildrye (*Elymus cinereus*), quackgrass (*Agropyron repens*), bluegrass, foxtail barley (*Hordeum jubatum*), bentgrass (*Agrotis gigantea*), rush (*Juncus arcticus*)	
Forb	525.1
Total	1557.4

Mountain Shrub

Grass/grasslike needle and thread, Indian ricegrass, bluebunch wheatgrass (*Agropyron spicatum*), western wheatgrass, bluegrass, threadleaf sedge (*Carex filifolia*), Douglas sedge (*Carex douglasii*)	106.3
Forb	20.5
Total	126.8

Grassland

Grass threadleaf sedge, western wheatgrass, Indian ricegrass, needle & thread	178.6
Forb	3.6
Total	182.2

Greasewood

Grass squirreltail, bluegrass, western wheatgrass	109.8
Forb	8.9
Total	118.7

Meadow

Grass bluegrass, foxtail barley, wheatgrass, inland saltgrass (*Distichlis spicata* ssp. *strictae*), American sloughgrass (*Bechmannia syzigacne*)	497.4
Forb	85.7
Total	583.1

Table II cont.
Summary of Mean Percent Canopy Cover and Plant Density of Shrub Species By Vegetation Type

Vegetation Type and Shrub Species	Canopy % Cover x	No. of Plants/Sq. Acre
RIPARIAN		
Artemisia cana	0.15	73
Artemisia tridentata	8.94	2875
Atriplex gardneri	TR	4
Chrysothamnus nauseosus	0.08	58
Chrysothamnus viscidiflorus	0.26	465
*Ribes aureum	0.08	29
*Rosa woodsii	2.64	3180
*Salix sp.	3.42	1133
Sarcobatus vermiculatus	0.17	116
Symphoricarpos albus	0.04	44
TOTAL	15.78	7977
MOUNTAIN SHRUB		
*Amelanchier alnifolia	0.01	4
*Artemisia nova	2.00	1481
*Artemisia tridentata	4.92	1624
*Cercocarpus montanus	3.92	842
Chrysothamnus nauseosus	0.24	145
*Chrysothamnus viscidiflorus	1.78	2628
Grayia spinosa	0.28	102
*Purshia tridentata	1.47	465
Ribes aureum	0.06	58
Rhus trilobata	0.07	44
Sarcobatus vermiculatus	0.01	9
*Symphoricarpos albus	0.06	58
Tetradymia canescens	0.37	523
TOTAL	14.58	7983
GREASEWOOD		
*Artemisia tridentata	4.18	2076
Atriplex confertifolia	0.05	73
*Atriplex gardneri	3.18	5881
Chrysothamnus viscidiflorus	0.48	218
Grayia spinosa	0.65	305
*Sarcobatus vermiculatus	12.15	3601
Tetradymia spinosa	0.06	9
TOTAL	20.75	12163

TR?1 = Less than 0.01 % Cover

*Indicates shrub species BLM considers most inportant.

Table II
Summary of Mean Percent Canopy Cover and Plant Density of Shrub Species By Vegetation Type

Vegetation Type and Shrub Species	Canopy % Cover $\bar{x}$	No. of Plants/Sq. Acre
SAGE		
**Amelanchier alnifolia*		15
**Artemisia tridentata*	22.28	7144
**Chrysothamnus viscidiflorus*	3.31	6621
**Grayia spinosa*	0. 6	15
Sarcobatus vermiculatus	0.17	29
Symphoricarpos albus	0.74	711
Tetradymia canescens	0.04	29
TOTAL	27.14	14642
SAGE-GRASS		
Artemisia nova	0.30	261
**Artemisia tridentata*	7.82	3383
**Atriplex confertifolia*	0.13	116
**Atriplex gardneri*	0.27	1568
Chrysothamnus nauseosus	0.11	73
**Chrysothamnus viscidiflorus*	1.23	2425
Grayia spinosa	0.56	305
Purshia tridentata	0.29	102
Sarcobatus vermiculatus	0.08	58
Symphoricarpos albus	0.01	15
Tetradymia canescens	0.38	319
Tetradymia spinosa	0.02	15
TOTAL	11. 2	8640
SALTBUSH		
**Artemisia tridentata*	0.68	290
Atriplex confertifolia	0.02	44
**Atriplex gardneri*	6.86	15493
Chrysothamnus nauseosus	TR	15
Chrysothamnus viscidiflorus	0.20	348
Sarcobatus vermiculatus	0.09	58
Tetradymia spinosa	0.03	15
TOTAL	7.88	16266

Table III
Summary of Mean Percent Canopy Cover for half-shrub species

Vegetation Type and Half-shrub Species	% Canopy Cover
SAGE	
*Atriplex gardneri	0.03
Ceratoides lanata	0.03
Leptodactylon pungens	0.03
TOTAL	0.63
SAGE-GRASS	
Artemisia pedatifida	0.02
Artemisia spinescens	0.02
*Atriplex gardneri	0.09
**Ceratoides lanata	1.0
Leptodactylon pungens	0.03
TOTAL	2.6
SALTBUSH	
Artemisia pedatifida	1.4
Artemisia spinescens	1.4
*Atriplex gardneri	9.4
**Ceratoides lanata	1.4
TOTAL	13.6
RIPARIAN	
Artemisia ludoviciana	0.3
TOTAL	0.3
MOUNTAIN SHRUB	
Artemisia frigida	0.2
Artemisia pedatifida	0.1
Leptodactylon pungens	0.7
TOTAL	1.0

Table III cont.
Summary of Mean Percent Canopy Cover for half-shrub species

Vegetation Type and Half-shrub Species	% Canopy Cover
GRASSLAND	
Artemisia frigida	0.01
Artemisia pedatifida	0.01
Artemisia spinescens	0.01
**Atriplex gardneri*	0.01
**Ceratoides lanata*	0.03
Leptodactylon pungens	0.01
TOTAL	0.62
MEADOW	
Atriplex gardneri	0.02
TOTAL	0.02

*RME's data shows atriplex gardneri was sampled as both a shrub and a half-shrub. This species has been retained in this table to be consistent with RME's data. The BLM Considers this species to be a shrub.

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